BEFORE THE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Petition for Emergency Action Pursuant to the Safe Drinking Water Act, 42 U.S.C. §300i, to Protect the Citizens of Kewaunee County, Wisconsin from Imminent and Substantial Endangerment to Public Health Caused By Nitrate and Bacteria Contamination of an Underground Source of Drinking Water, and Pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. § 9604, and Resource Conservation and Recovery Act, 42 U.S.C. § 6973	)	EPA Docket No. __________ October 22, 2014

RESPONSE AND SUPPLEMENTAL INFORMATION IN OPPOSITION TO PETITION OF MIDWEST ENVIRONMENTAL DEFENSE CENTER, ENVIRONMENTAL INTEGRITY PROJECT, MIDWEST ENVIRONMENTAL ADVOCATES, CLEAN WISCONSIN, CLEAN WATER ACTION COUNCIL OF NORTHEASTERN WISCONSIN, AND KEWAUNEE CARES

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For the reasons set forth below, the undersigned farmers ("Kewaunee County Farms" or the "Responding Farms") respectfully request that the U.S. Environmental Protection Agency ("EPA") deny the October 22, 2014 "petition"[1] submitted by the Midwest Environmental Defense Center, Environmental Integrity Project, Midwest Environmental Advocates, Clean Wisconsin, Clean Water Action Council of Northeastern Wisconsin, and Kewaunee CARES (collectively, "Petitioners") requesting that the Administrator exercise the Agency's emergency powers pursuant to the Safe Drinking Water Act ("SDWA"), 42 U.S.C. § 300i, as well as the Agency's powers pursuant to Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA") and Section 7003 of the Resource Conservation and Recovery Act ("RCRA") (the "Petition").

INTRODUCTION

The Petition requests that EPA exercise the Agency's emergency powers pursuant to the SDWA, as well as its powers under CERCLA and RCRA, to address alleged nitrate and bacteria groundwater contamination in Kewaunee County, Wisconsin by investigating 15 specific large dairy farms, or concentrated animal feeding operations ("CAFOs" or the "Kewaunee County CAFOs"). Petitioners request that EPA use its emergency powers to "investigate and address groundwater contamination that has presented, and continues to present, an imminent and substantial endangerment to the health of the residents of Kewaunee County, Wisconsin." The nitrate and bacteria contamination in private well water that is the focus of the Petition is not an "imminent and substantial endangerment" and is present, at similar or higher levels, in private wells throughout the State of Wisconsin and the Midwest. Just as problematic, the Petition

[1] While Petitioners use the term "Petition" to describe their request to EPA, it should be noted that Petitioners have no standing or statutory authority to "petition" action from the EPA under 42 U.S.C. § 300i. The SDWA emergency powers only authorize EPA to take action, as deemed necessary, upon *receipt of information* regarding the contamination of drinking water supplies. We understand this request to be nothing but an attempt at a conveyance of information pursuant to 42 U.S.C. § 300i, and EPA is under no duty to respond to such information.

offers absolutely no evidence that the 15 identified Kewaunee County CAFOs are the cause of any purported groundwater contamination. Emergency action pursuant to the SDWA, as well as CERCLA and RCRA, is not warranted for the reasons outlined herein.

BACKGROUND

Kewaunee County's groundwater is on par or better than the state and regional averages for nitrate and bacteria contamination.

Petitioners request emergency action under the SDWA to address nitrate and bacteria contamination of private wells in the northeastern Wisconsin County of Kewaunee. According to the 2014 Wisconsin Groundwater Coordinating Council Report to the Legislature, surveys by two state agencies and meta-analysis of state databases indicate 9 to 11% of private wells statewide exceeded the nitrate enforcement standard (ES) of 10 mg/L. *See* Pet. Ex. 20 at 2. The highly cultivated areas of south-central Wisconsin have the highest exceedance rates with 21% of private wells exceeding the ES for nitrates. *Id.* ("20-30% of the privately owned wells in Calumet, Columbia, Dane, La Crosse and Trempealeau counties exceed the 10 mg/L nitrate standard."). Therefore, although perhaps unfortunate, nitrate contamination is a statewide issue and is not at all unique to Kewaunee County. *Id.* ("nitrate is Wisconsin's most widespread groundwater contaminant"). In fact, as outlined below, Kewaunee County's private well statistics are *the same or better than* the state and regional average for nitrate contamination.

The Petition's most basic premise, i.e. groundwater in Kewaunee County "consistently exceed[s] state and federal drinking water standards for nitrate and routinely test[s] positive for the presence of bacteria," is flawed and misleading. Pet. at 2. To support their request for county-wide emergency action, Petitioners rely on a UW Stevens Point study that focused on ten (10) wells in one township (Town of Lincoln), and the study gave preference to sampling wells that had a "history of previously measured nitrate-nitrogen concentration greater than 10 mg/L and/or a positive coliform/E-coli bacteria test." Pet. Ex. 1 at 9; Map of Kewaunee County, attached as Ex. 1. This limited study actually revealed a high level of variability in results for most of the tested wells in the town, not consistent and widespread contamination.[2] Moreover, this study is irrelevant to the state of private wells countywide. The study does not support Petitioners' request for EPA emergency action. To the contrary, the study recommends additional monitoring to identify wells that are "most susceptible to geologic conditions." Pet. Ex. 1 at 32. This suggests the condition of the private wells themselves may be a contributing concern. Further, the study does not attribute the cause of groundwater conditions to the CAFOs located in the town (much less countywide) but noted that significant variability was observed in "nitrate and chloride concentrations, both human-related contaminants." *Id.*

The Petition notes that "nearly a third (30.85%) of tested wells in the county contained bacteria, nitrate, or both at levels that exceed state and federal public health standards."[3] Pet. at 2-3. Petitioners appear to rely on well sampling data from UW Stevens Point to support this statistic; however, Petitioners provide no scientific explanation or statistical method for their interpretation of the data. The well sampling data, as applied by Petitioners, is skewed by a disproportionate number of samples originating from towns with historically high levels of nitrates, and, the sampling subset was self-selected—meaning, wells were selected based upon the cooperation and urging of well owners.[4] As a result, the data in Petitioners' Ex. 3 should be

[2] This is particularly true when bacterial counts were examined. It was not unusual for a well to test positive for coliform bacteria one month and then test negative the following month. Pet. Ex. 1 at 3, 18. None of the wells tested positive for *E. coli* during any of the twelve testing cycles. Pet. Ex. 1 at 17. Instead, the positive bacteria tests were due to the presence of coliform bacteria, which can be from humans or animals, and which typically present no health risk to humans. Pet. Ex. 1 at 6.

[3] The state standards call for all wells to be bacteria free. This is remarkably strict given how prevalent coliform bacteria are in wells in Wisconsin and around the country. These bacteria are literally located on all manner of surfaces and can come from any number of sources.

[4] Wells from the three towns (Red River, Lincoln, and Luxemburg) that form the county's northwestern corner make up 46% of the wells that were tested, although those towns contain nowhere near 46% of the total private wells in the county. When data from those three towns are excluded from results in Petitioner's Exhibit 3, the percentage of

viewed as overstating the true scope of the county's water quality issues. Again, more importantly, the study in no way relates the well data to agricultural practices in general, or Kewaunee County's CAFOs in particular.

According to the 2014 Wisconsin Groundwater Coordinating Council's report to the legislature, on average 9 to 11 percent of wells throughout the state have tested positive for nitrates above 10 ppm (or 10 mg/L). Pet. Ex. 20 at 2. Even the skewed data from UW-Stevens Point puts Kewaunee County squarely within the Coordinating Council's statewide average at 10.3% of wells tested having nitrates at 10 ppm or higher. According to Petitioners' Exhibit 3, coliform bacteria were present in 19.86% of wells tested. This number, which almost certainly overstates the problem, is below the state average (23%) reported by DNR. *See* attached Ex. 2 at 1. Only the percentage of wells that tested positive for *E. coli* (3.93%) is actually higher than a state average (2.4%) according to DNR and *E. coli* may be caused by a number of sources, including humans. *Id.*

To compare Wisconsin to other Midwestern states, in Iowa, 18.3% of wells tested in a 1993 statewide private well survey contained 10 ppm of nitrates or higher and 44.6% contained unsafe levels of coliform bacteria. *See* attached Ex. 3 at 1. Both are far higher than Wisconsin's numbers as reported by DNR. *See* attached Ex. 3 at 1. Some regions in Iowa were much worse than the statewide data. For example, Western Iowa had nitrates above 10 ppm in over 32% of wells and unacceptable levels of coliform bacteria in over 60% of its wells. *Id.* at 3. A 1998 Center for Disease Control (CDC) survey found that Wisconsin had the lowest percentage of wells containing coliform bacteria of any of the nine Midwestern states reviewed (Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin). *See*

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wells that tested positive for *E. coli* drops to 1.15% and the percentage with nitrates over 10 ppm drops to 4.98%. Additionally, these three towns are not a locus of CAFO operations. Only four CAFOS operate in the three towns, and the other eleven are spread throughout Kewaunee County.

attached Ex. 4 at 12-13. According to the CDC survey, Wisconsin had the second lowest percentage of wells with *E. Coli* and nitrate levels exceeding 10 ppm. *Id.* When compared to the CDC data from Midwestern states, Petitioners' Exhibit 3 demonstrates that: 1) Kewaunee County's coliform bacteria levels are lower than all other states overall; 2) Kewaunee County's *E coli* prevalence is only higher than Wisconsin and Nebraska; and 3) the percentage of Kewaunee County wells with nitrate levels above 10 ppm was lower in Wisconsin, Minnesota, and Missouri. *Id.* These numbers clearly dispute the notion that something unique and emergent is occurring in Kewaunee County that would warrant EPA's emergency action.

The number of CAFOs in Kewaunee County is irrelevant to whether EPA emergency action is warranted; Petitioners cannot connect Kewaunee County CAFOs to the identified groundwater contamination in Kewaunee County.

The Petition is fixated on the number of cows in Kewaunee County and the growth of CAFOs in the area. Indeed, Petitioners fill several pages of their Petition with statistics regarding Kewaunee County's "cattle density" or cow-to-human ratio. *See* Pet. at 3-5. All of this is Petitioners' attempt to draw attention away from the fact that they have no information whatsoever to support a conclusion that the complained-of groundwater contamination in the county is caused by dairy farming practices in general or by these 15 Kewaunee County CAFOs in particular. Petitioners have no such information, have presented no such information to EPA, and therefore have not met the SDWA's §300i criteria.

To be clear, concern about an increasing cow population would only be justified if there was a clear correlation between cow population and well contamination. An analysis of UW-Stevens Point well data from all 72 Wisconsin counties and cow and human population data from Wisconsin state agencies shows no statistically significant correlation between a county's cow or human population density and the percentage of wells in that county with nitrates above the 10 ppm level. *See* attached Ex. 5.[5]

Petitioners claim that the "land application of liquid manure and other agricultural wastes are undeniably the leading source of [nitrate and bacteria contamination]" and "leaking septic tanks, land-application of industrial wastes or sewage sludge, or other activities play a relatively small role in the degradation of the county's groundwater supplies." Pet. at 5. This biased declarative statement is simply not supported by the research Petitioners cite.

While the researchers who prepared Petitioners' Exhibit 1 (the UW Stevens Point Town of Lincoln Study) note that elevated nitrate levels in the ten wells samples is from "accepted agricultural management practices and not the result of gross mismanagement or negligence," the study also noted that "[w]hile concentrations above 2 mg/L provide confirmation of being impacted by *one or more human-related activity*, the extent to which nitrate occurs in Lincoln wells is also *largely a function of the soils and geology*." Pet. Ex. 1 at 23 (emphasis added). Regarding bacteria, Petitioners' Exhibit 16 summarizes the testing of only 10 wells in Kewaunee County in May 2014. Three of the ten wells tested positive for bacterial contamination from human sources. Three of the ten wells also tested positive for bacterial contamination from animal sources. Some of the wells (6 in total) also showed evidence of contamination from *E. coli*, *Salmonella*, and *Campylobacter jejuni*, which are contaminants that could have come from human or animal sources or potentially both.[6] *See* Pet. Ex. 16 at 1. In short, Petitioners do not

[5] Exhibit 6 was prepared by Dr. Greg Bethard who works for two CAFOs in Kewaunee County. The data included here is for 2013, but Dr. Bethard compiled data for every year from 1989-2013. Dr. Bethard relied on UW-Stevens Point well data from all 72 Wisconsin counties, cow population data from the Wisconsin Department of Agriculture, Trade, and Consumer Protection, and human population data from the Department of Health Services to compile Exhibit 6.

[6] There is no denying that human waste plays a significant role in well bacterial contamination. Due to the species-specific nature of many pathogens, contamination by human waste is a far more worrisome public health threat. There is reason to suspect that a great many of the septic tanks in the county are failing. A survey of systems in neighboring Door County revealed that 26% of the inspected systems were failing and nearly half of those failures

provide any information that supports their premise that nitrate and bacteria contamination in Kewaunee County's private wells are caused by the 15 identified CAFOs.

DISCUSSION

I. The Petition does not warrant emergency action under the Safe Drinking Water Act

Although EPA's emergency powers under the SDWA are significant, they are not unlimited. The very fact that the statute uses the term "emergency powers" indicates that Congress did not intend for EPA to rely on 42 U.S.C. § 300i(a) to address statewide groundwater quality issues. Congress authorized EPA to take emergency action only when "necessary" to protect public health from "an imminent and substantial endangerment" caused by drinking water contamination. 42 U.S.C. § 300i(a). If those criteria are met, before exercising its emergency powers, EPA must then determine that "appropriate State or local authorities have not acted to protect those persons so endangered." *Id.* The Petition fails to meet any of these standards. Petitioners do not establish that emergency action is necessary, that there is an imminent and substantial endangerment to the public's health or that State or local authorities have failed to protect the public. Instead, Petitioners assert broad assumptions and make biased accusations in the absence of scientific support regarding the identified Kewaunee County CAFOs that may advance Petitioners' "anti-CAFO agenda" but that fail to meet the statutory prerequisites for EPA's exercise of emergency power under the SDWA.

A. There is no "Imminent and Substantial Endangerment" to Public Health

Petitioners contend that EPA should exercise its emergency powers because nitrates and bacteria have been identified in certain private wells in Kewaunee County in excess of EPA and

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were due to faulty septic tanks. See attached Exhibit 6 at 1. The EPA's own research has shown that 80-90% of the nitrogen released by septic systems can be expected to leach into the surrounding soil. This is many times the nitrogen loss that is expected from agricultural fields. See attached Exhibit 7 at 10.

DNR established maximum allowable contaminant levels ("MCLs") and, based on those facts alone, the public health endangerment in Kewaunee County is both imminent and substantial. Pet. at 22. Petitioners' analysis is contrary to the explicit language of the SDWA and Congressional intent.

It is understood that the SDWA "confers on EPA broad authority to address present and future harm that may substantially threaten the health of persons who use public water systems. Yet, the EPA's emergency power is not without limitation." *W.R. Grace & Co. v. U.S. EPA*, 261 F.3d 330, 339-340 (3d Cir. 2001) (citing H.R. Rep. No. 93-1185 (1974), reprinted in 1974 U.S.C.C.A.N. 6454, 6487-88). "The same House Report that expresses an intent to confer broad emergency authority on the EPA also explains that, '[i]n using the words 'imminent and substantial endangerment to the health of persons,' the Committee intends that this broad administrative authority *not be used when the system of regulatory authorities provided elsewhere in the bill could be used adequately to protect the public health.*' H.R. Rep. No. 93-1185 (1974), reprinted in 1974 U.S.C.C.A.N. 6454, 6487-88. 'Nor is the emergency authority to be used in cases where the *risk of harm is remote in time, completely speculative in nature, or de minimis in degree*.' *Id.* at 6488." *Id.* at 339-40 (emphasis added).

While imminence does not require an existing harm, it does require "an ongoing threat of future harm." *Albany Bank & Trust Co. v. Exxon Mobil Corp.*, 310 F.3d 969, 972 (7th Cir. 2002) (considering "imminent and substantial endangerment" in the RCRA context). Further, the harm must pose "a near-term threat." *Me. People's Alliance v. Mallinckrodt, Inc.*, 471 F.3d 277, 288 (1st Cir. 2006). Thus, satisfaction of the imminence requirement necessitates a showing that a risk of threatened harm is present now. *See Crandall v. City & County of Denver*, 594 F.3d 1231, 1237 (10th Cir. 2010); *Cordiano v. Metacon Gun Club, Inc.*, 575 F.3d 199, 210 (2d Cir.

2009); *Avondale Fed. Sav. Bank v. Amoco Oil Co.*, 170 F.3d 692, 695 (7th Cir. 1999) ("Thus, off-site contamination may very well present an imminent and substantial danger *at some time*, but it does not present such a danger *right now*.") (emphasis added).

With respect to the "substantial" component, courts agree that the endangerment must be serious and must require action. *Cordiano*, 575 F.3d at 210-11 (citing list of cases in RCRA context). *See also Tilot Oil, LLC v. BP Prods. N. Am., Inc.*, No. 09-CV-201-JPS, 2012 U.S. Dist. LEXIS 5365, at *19-20 (E.D. Wis. Jan. 17, 2012) ("As to a substantial danger, the threat must be serious and 'there must be some necessity for action.'" (quoting *Price v. United States Navy*, 39 F.3d 1011, 1019 (9th Cir.1994))).

Here, Petitioners offer no evidence that a contaminant causing an "imminent and substantial endangerment" is emanating *from* the identified Kewaunee County CAFOs. To the contrary, publicly available data from at least three (3) of the identified Kewaunee County CAFOs indicate that private wells on these CAFOs (alleged sources of contamination if one were to believe the Petitioners) tested <u>below</u> the MCL for nitrates. *See* Exhibit 8, DNR Drinking Water Data for Dairy Dreams LLC (most recent nitrate sample taken in November 2014 of 8 mg/l), Kinnard Farms Inc. (most recent nitrate sample taken in February 2014 of 1.01 mg/l), and Pagel's Ponderosa Dairy (most recent nitrate sample taken in March 2014 of 0.066 mg/l). In fact, Petitioners concede that they do not have any information that associates the identified CAFOs with nitrate or bacteria contamination in Kewaunee County. *See* Pet. at 34. (requesting EPA "begin evaluating the imminent and substantial endangerment to public health in the County by *conducting an investigation to trace pollutants from these facilities'* manure lagoons and waste applications fields, as well as testing the residential wells of nearby and down-gradient residents for indicators of bovine fecal contamination.") (emphasis added). Apparently, Petitioners think it is enough for them to assume that any observed contamination (at any level, anywhere in the County) can be traced back to the identified CAFOs. Such an assumption does not rise to the level of EPA exercising its emergency powers.

Even if wells at these CAFOs did demonstrate exceedances of the MCL for nitrates or bacteria, merely having contamination levels that exceed government screening levels is insufficient to establish *ipso facto* an immediate and substantial endangerment. Courts, in considering the "imminent and substantial endangerment" threshold in RCRA, have held that contamination levels that exceed government screening or action standards do not alone establish the necessary near-term threat of serious harm. *See Cordiano*, 575 F.3d at 212-13 ("Even the most cursory review of Connecticut law, moreover, strongly suggest that the mere fact that some samples taken from the Metacon site may exceed Connecticut's RSR standards provides an insufficient basis for a jury to find a reasonable prospect of future harm that is both 'near-term and ... potentially serious." (quoting *Me. People's Alliance*, 471 F.3d at 296)); *Lewis v. FMC Cop.*, 786 F. Supp. 2d 690, 710 (W.D.N.Y. 2011) ("Without any evidence linking the cited standards to potential imminent and substantial risks to human health or wildlife, reliance on the standards alone presents merely a speculative risk of future harm, the seriousness of which is equally hypothetical."). Petitioners rest entirely on the premise that a few private well samples with a mean nitrate concentration in excess of the MCL rise to the level of an "imminent and substantial endangerment." Pet. at 10 (citing Kewaunee Conservation Department "study" of 10 wells in the Town of Lincoln). This is not the SDWA's applicable threshold.

Further, Petitioners have failed to show that the observed levels of bacteria and nitrates are, in fact, an "imminent and substantial endangerment." Nor could they do so. *Compare Trinity Am. Corp. v. EPA*, 150 F.3d 389, 399 (4th Cir. 1998) (SDWA emergency action at toxic waste site with known historic dumping of solvent vats on a property located next to a hundred homes relying on well water from contaminated aquifer and violating a state remedial action consent decree); *W.R. Grace & Co. v. EPA*, 261 F.3d 330, 334-35 (3d Cir. 2001) (SDWA emergency action not upheld at federal Superfund site with fertilizer plant causing ammonia groundwater contamination and undergoing remediation due to impacts to the public water treatment plant). As explained below, *public* water systems can distribute water with up to 10 mg/L nitrates and be within state and federal guidelines, and even distribute water containing up to 20 mg/L nitrates with additional obligations.

Here, Petitioners are not only asserting that *any* exceedance of an MCL constitutes an "imminent and substantial endangerment" worthy of emergency action, they are asserting that *any* exceedance in *any* well in the *County* is grounds for an emergency action against the Kewaunee County CAFOs, regardless of how those wells or exceedances relate to the Kewaunee County CAFOs. If this were Congress' intent, EPA would essentially have the authority to act, unconstrained, in every county in the United States, against any party, for any reason. Such an interpretation is contrary to the explicit statutory language of the SDWA.

B. <u>Emergency Action is not Necessary</u>

Besides not being able to establish that the Kewaunee County CAFOs are causing an imminent and substantial endangerment, the Petitioners also fail to establish that emergency action is necessary. Congress intended that EPA's "broad administrative authority 'not be used when the system of regulatory authorities provided elsewhere in the bill could be used adequately to protect the public health.'" H.R. Rep. No. 93-1185 (1974), reprinted in 1974 U.S.C.C.A.N. 6454, 6487-88, attached Exhibit 9. The SDWA sets national standards for drinking water, which States must meet or exceed. In Wisconsin, DNR is responsible for implementing the SDWA. The state and federal drinking water standards are found in Wisconsin Administrative Code NR 809 and apply to "all new and existing public water systems and water suppliers." Wis. Admin. Code NR 809.03. Public water systems and water suppliers are required to conduct routine monitoring. If a contaminant, such as nitrate, is detected above the MCL, then additional monitoring, reporting and notification requirements apply. *See* NR 809.115(4), 117. The SDWA provisions prohibit a water source exceeding any primary MCL to be connected to a public water system unless blending or treatment is provided such that the primary MCL is not exceeded upon entry to the distribution system. *See* NR 809.09. Private well owners are not considered a "public water system" or a "water supplier" and are not regulated by NR 809. NR 809.04(67), (91). Instead, private well owners must adhere to the well construction and installation requirements of NR 812. *See* NR 812; NR 845 (County Administration of NR 812, Private Well Code).

To provide necessary context, state and federal regulations allow public water systems to supply water to the public with nitrate levels in excess of the 10 mg/L MCL—and up to 20 mg/L if certain conditions are met. *See* NR 809.11(3) (allowing nitrate levels above the MCL of 10 mg/L and up to 20 mg/L in a non-community water system if the water supplier demonstrates certain public notification requirements are met, local and state public health authorities are given annual notification, alternative water sources are provided for infants under 6 months of age and no adverse health effects will result); see also 40 CFR § 141.209 (special notice provisions for nitrate exceedances above MCL by non-community water systems). Further, private well owners are not even eligible for DNR's well compensation program until a private well's nitrate levels exceed 40 mg/L. *See* NR 123.03. The public water systems in Kewaunee County do not have exceedances for nitrate or bacteria. *See* Exhibit 10, DNR Drinking Water

Data for Kewaunee Co. Public Water Systems. Nitrate levels at the public water systems in Kewaunee County are at or below 1 mg/L according to their 2013 consumer confidence reports (Algoma Waterworks with nitrate levels of 0.04 mg/L, Kewaunee Waterworks with nitrate levels of 0.07 mg/L and Luxemburg Waterworks with nitrate levels of 1.1 mg/L). *Id.*

Third Circuit case law illustrates the importance of the necessity requirement for emergency action under the SDWA that is not met here. In *W.R. Grace*, the Third Circuit vacated an EPA order under the SDWA because the emergency action order did not provide a rational explanation that the remediation mandate of the order was "necessary to protect the … public's health." *W.R. Grace & Co. v. EPA*, 261 F.3d. 330, 344 (3d Cir. 2001). The respondent in W.R. Grace was a single entity whose site was a CERCLA Superfund Site. The state agency, Michigan Department of Environmental Quality ("MDEQ"), notified EPA that the agency was concerned the ammonia clean-up level at the Superfund Site compromised the City of Lansing's public health. There were no state or federal MCLs for ammonia. *Id.* at 334.

A technical evaluation team was formed (including representatives from the respondent, the Lansing Board, EPA and MDEQ) that issued a report identifying and evaluating four separate approaches to protect public health from excess ammonia in the aquifer. *Id.* at 335-36. The committee recommended one approach, the total remediation of the aquifer (Approach 1), but this option would take two years to complete and interim protections would be necessary. To protect public health in the meantime, the committee recommended the three other approaches could be used to sufficiently meet drinking water standards, but not totally remediate the aquifer. *Id.*

EPA then issued an Emergency Order that required the respondent to begin implementing Approach 1 (remediation of the aquifer), but to protect the drinking water in the interim through the second approach to. *Id.* at 337. The respondent filed a petition challenging EPA's authority to issue the Emergency Order under the SDWA. *Id.*

On review, the court held that EPA "failed to articulate a rational basis for its conclusion that Approach 1 is *necessary* to protect the health of the Lansing public." *Id.* at 342 (emphasis added). The remedy prescribed by EPA (Approach 1) was not a necessary approach when the technical committee identified multiple remedies to sufficiently protect public health, and EPA had not rationally explained why Approach 1 was preferred. *Id.* at 342. EPA failed to rationally base its recommendation of one approach over the others, since all would protect public health. *Id.* at 344.

Here, the Petition does not establish that the requested remedies are necessary to protect Kewaunee County's citizens from nitrate and bacteria contamination, even if there were nitrate and bacteria contamination that necessitated protection. Petitioners broadly request that EPA conduct "an investigation to trace pollutants from these facilities' manure lagoons and waste applications fields, as well as testing the residential wells of nearby and down-gradient residents for indicators of bovine fecal contamination" and "consider" supplying clean drinking water to any resident of Kewaunee County whose well water exceeds "safe limits" for nitrate and pathogens, installing groundwater monitoring wells to further assess the extent of pollution in Kewaunee County's groundwater and investigate whether Wisconsin's nutrient management standards are sufficient to protect groundwater from contamination in areas of karst topography. Pet. at 34.

With substantially less support than what was deemed insufficient in *W.R. Grace & Co.*, Petitioners fail to demonstrate that any one of these actions, let alone all of them, are necessary to protect public health. For example, even if there were wells with high nitrates at the identified

CAFOs, Petitioners do not address whether well-replacement efforts or well inspections to ensure area wells meet state specifications would be sufficient to address any public health concerns. Instead, Petitioners' requested response actions that have no connection to the perceived public health risks and are a pretext for what Petitioners actually seek to stop—the continued operation of CAFOs in Kewaunee County.

C. Petitioners cannot show that appropriate state and local authorities have not acted to protect the purported endangerment

Under the "emergency powers" section of the SDWA, "action by the EPA is only authorized when state and local authorities have not acted first." *W.R. Grace Co.*, 261 F.3d. 330 at 339. EPA's SDWA Guidance notes that:

> One of the crucial requirements of a SDWA 1431 enforcement action is that "appropriate State and local authorities have not acted to protect the health of such persons." Courts have held that "receipt of such information is a jurisdictional prerequisite to action under this section. Section 1431 "should not be used to deal with problems that are being handled effectively by State or local governments in a timely fashion."

Guidance, at 7. In enacting 42 U.S.C. §1431, Congress directed EPA to "refrain from precipitous preemption of effective State or local emergency abatement efforts." H.R. Rep. No. 93-1185, at 35 (1974), reprinted in 1974 U.S.C.C.A.N. 6454, 6487-88, attached Exhibit 9.

Petitioners assert that EPA emergency action is necessary because neither the DNR nor the Department of Agriculture, Trade and Consumer Protection ("DATCP") nor Kewaunee County nor any other unit of local government has acted to protect the health of the public of Kewaunee County from nitrate and bacteria contamination. In fact, DNR and DATCP are very active on groundwater contamination issues in the state—the agencies' efforts are just not focused on Kewaunee County because several other areas of the state have much more significant groundwater contamination concerns. For example, in 2012 DNR began working with stakeholders on the "Wisconsin Safer Drinking Water Nitrate Initiative" targeted at "reducing nitrate levels in groundwater by making the most efficient use of nitrogen in agricultural productions." *See* Pet. Ex. 20 at p.2. The selected project areas, Rock and Sauk Counties, are "subwatersheds with large numbers of public drinking water systems approaching unsafe levels of nitrate contamination." *Id.*

In an effort to show state and local authorities have not acted to protect the health of persons in Kewaunee County, Petitioners assert that DNR has failed to take responsive action authorized pursuant to NR 140 and Wis. Stat. Ch. 160. Pet. at 22. However, Petitioners misconstrue the purpose and scope of these groundwater laws. Wis. Stat. Ch. 160 sets groundwater protection standards and NR 140 provides the "guidance and procedures" for managing groundwater quality issues that are intended to "supplement[ ] the regulatory authority elsewhere in the statutes and rules." NR 140.02.

When the results of a private well sampling exceed a preventative action limit (PAL) or enforcement standard (ES), the owner or operator of the facility must notify the DNR within 10 days after receiving the results. *See* NR 140.24(1)(a); NR 140.26(1)(a). Data submitted to DNR must meet a minimum scientific and statistical threshold to trigger the potential for a response action under NR 140. *See* NR 140.14 (setting statistical standards); NR 140.16 (setting laboratory requirements for samples to determine compliance with Wis. Stat. ch. 160). If DNR is presented with data sufficient to demonstrate an exceedance of a PAL or ES, DNR must "evaluate the information" and determine the appropriate response. NR 140.24(1)(b)-(c); NR 140.26(1)(b)-(c). When evaluating the information submitted, DNR must consider the background water quality as well as the reliability of the sampling data. NR 140.24(1)(c)(1)-(2); NR 140.26(1)(c). NR 140 then provides DNR with numerous response options depending on the specific facts, circumstances, and data, but no specific response is mandated by NR 140. NR 140.24.[7] Moreover, if nitrates exceed the ES, DNR is "not required to impose a prohibition or close a facility" if it was caused, in whole or in part, by high background concentrations and the concentration does not present a public welfare concern. NR 140.26(3).

While the Petitioners assert DNR has failed to respond to their sampling data, Petitioners have not established that they properly reported the data or provided DNR with sufficient data that meets the statistical and scientific procedures required by NR 140 for DNR to make an informed regulatory decision. Response actions by DNR cannot be triggered by discrete samples. Even if the data was accepted as meeting regulatory standards, Petitioners have not presented any evidence of contaminant background levels to accompany their data for DNR consideration. NR 140.28 (granting exemptions to NR 140 based on background concentrations); NR 140.26. To perform the response action requested by Petitioners, DNR would need to set up an NR 141 ("Groundwater Monitoring Well Requirements") compliant monitoring plan, analyze the data from the monitoring wells, and then apply the data in a response action, if necessary. NR 140 does not *require* a specific response action by DNR, as Petitioners assert, therefore, DNR has responded to information presented by Petitioners (if that has actually happened) in a manner within its NR 140 authority. NR 140.23(2)(a)("The range of responses which the department *may* take or *may* require . . . is listed in Table 6.") (emphasis added); NR 140.24(4).

If anything, Petitioners use of NR 140 illustrates how Wisconsin's regulatory system *has acted* to protect the health of persons affected by groundwater contamination. NR 140 requires regulated facilities that "may affect groundwater" to alert the state when a groundwater

[7] Specifically, Table 5 in NR 140.24 provides 12 response options if a PAL is exceeded, from taking no action at all to requiring a change in the design of a regulated facility, practice, or activity. Table 6 in NR 140.26 provides eight response options if an ES is exceeded.

monitoring well exceeds a preventative action limit. DNR then considers this information, and, if necessary, will require further action. For example, in DNR's reissuance of a WPDES permit to a dairy farm in Adams County, the agency required specific design requirements to prevent further nitrate contamination and response actions, including groundwater monitoring, pursuant to NR 140. *See* attached Exhibit 11. In addition, DNR has broad regulatory authority to impose additional restrictions, including restrictions more stringent than the requirements of Wis. Admin. Code NR 243, when DNR deems necessary to prevent exceedances of groundwater quality standards, prevent runoff of manure or process wastewater runoff events or discharges from a site to waters of the state, even if such activities are in compliance with NR 243 and the conditions of a WPDES permit. *See* Wis. Admin. Code § NR 243.14(10).

The Petitioners acknowledge the county's recently passed winter manure spreading ordinance. Pet. at 28. Paradoxically, they are critical of agricultural groups that warned the county's approach might exceed its legal authority, but then they echo those groups' arguments as to why the county cannot enforce such regulations. *Id.* at 28-29. The county board ultimately concluded this measure was worthwhile and it passed with support from the one dairy CAFO owner (whose facility is named in the Petition) on the county board. Local leaders are also pursuing other measures to improve water quality that have no risk of being illegal. For example, Kewaunee County Board Chairperson Ron Heuer has an ambitious plan to have the manure from 20,000 of the county's cattle treated by a combined digester and UF/RO treatment system by August 2017. Ron Heuer, *Kewaunee Co. Update - Jan 22*, Political, County Board and General County Updates and Stories from the County (Jan. 25, 2015, 4:24 AM), http://www.ronheuer.com.

II. <u>**Petitioners cannot establish that Kewaunee County CAFOs caused or contributed to the alleged contamination.**</u>

Congress gave EPA authority to issue an emergency order to a "person whose action or inaction requires prompt regulation to protect public health." H.R. Rep. No. 93-1185, at 35 (1974), reprinted in 1974 U.S.C.C.A.N. 6454, 6487. Petitioners have failed to identify any rational connection between the identified issue (nitrate and bacteria contamination in private well water groundwater) and the 15 Kewaunee County CAFOs named in the Petition. In fact, one of the Petitioners has acknowledged that there is insufficient information to establish that *these* CAFOs are contributing to groundwater contamination, unlike the circumstances in Yakima Valley, Washington. *See* Kate Prengaman, *Wisconsin dairies, environmentalists watching closely after waste ruling,* Yakima Herald.com (Jan. 16, 2015), attached at Ex. 12.

Petitioners do not offer any information to indicate that any of the identified 15 Kewaunee County CAFOs caused nitrate contamination by their "action or inaction." Instead, Petitioners would like EPA to just assume that the county's largest dairy operators must be the cause. Petitioners' assumptions (and preference to hold CAFOs responsible for a statewide and nationwide groundwater quality issue) do not pass statutory muster.

Petitioners cite to the *Trinity Am. Corp. v. EPA* decision for its SDWA emergency action standard. Pet. at 31 (citing *Trinity Am. Corp. v. EPA*, 150 F.3d 389, 397 (4th Cir. 1998)). The stark contrast between the underlying facts in this Petition compared to the circumstances of *Trinity* provide context. In *Trinity*, EPA issued an emergency order pursuant to the SDWA. *Trinity*, 150 F.3d at 393. In that case, Trinity had been cited by state and local authorities for "numerous instances of improper waste handling and dumping of hazardous materials." *Id.* at 392-93, 396. Here, unlike in *Trinity*, the Petitioners cannot point to a culpable party. Petitioners do not identify a single "instance of improper waste handling" or "dumping of hazardous materials" and do not even attempt to argue (because they cannot) that the nitrate and bacteria exceedances at issue originated with the 15 Kewaunee County CAFOs that are the target of the Petition. Instead, Petitioners seek an emergency order to allow the collection of data in an attempt to confirm Petitioners' "witch hunt" hypothesis that Kewaunee County CAFOs have caused, apparently en masse, any nitrate exceedance in Kewaunee County. This is far beyond that which the SDWA's emergency action authority was intended and Petitioners' approach blatantly exceeds Congress' grant of authority to EPA.

Not only does the Petition fail to identify a culpable party "whose action or inaction requires prompt regulation to protect public health," the Petition defeats itself by requesting that EPA use its emergency action authority to <u>only</u> investigate permitted CAFOs. Petitioners' requested relief reveals its Petition is truly motivated as a frontal assault on CAFOs, not an attempt to solve a problem. Petitioners acknowledge that there are approximately 200 dairies in Kewaunee County but request that EPA exercise its emergency action authority only with respect to the Kewaunee County CAFOs because Petitioners claim it is these "large livestock operations most likely driving contamination of Kewaunee County's drinking water resources." Pet. at 3. Congress did not authorize EPA to exercise its emergency authority over purely speculative cases where Petitioners assert from the height of speculation that these 15 CAFOs are "most likely driving contamination." *Id.*

Remarkably, Petitioners attempt to demonize the use of a NMP, and claim the number of Kewaunee County acres under nutrient management somehow <u>increases</u> the risk to groundwater. Pet. at 17. In reality, the DNR and DATCP invest significant resources to <u>increase</u> the number of Wisconsin acres covered under nutrient management. That is because "[n]utrient management planning is one of the best practices farmers can use to reduce excess nutrient applications to their cropland and the water quality problems that result from nutrient runoff to lakes, streams and groundwater." DATCP 2013 Nutrient Management Report (available at http://datcp.wi.gov/uploads/Farms/pdf/2013NutrientMgmtNews.pdf.). The DATCP 2013 Report goes on to boast that in 2013, more acreage was covered under NMPs than any other time in Wisconsin's history. *Id.* ("The degree to which nutrient management has been implemented around these wells (89%) is extensive, Kewaunee County is second (by percent of crops acres) in the state for implementation of crop acres with a nutrient management plan.").

Although CAFOs are required to implement NMPs, non-CAFOs can also utilize NMPs. While the Wisconsin Administrative Code requires all farms that mechanically apply manure or commercial fertilizer to cropland to have a nutrient management plan (Wis. Admin. Code § 50.04), this general requirement is only enforced if a farm is a CAFO, accepts state cost-sharing funds, voluntarily participates in the Farm Land Preservation Program, or is subject to local livestock siting or manure storage ordinances. Wis. Admin. Code §§ ATCP 50.08, 50.16, 50.54(2)(b). Although some farms implement NMPs voluntarily, the fact is many unregulated farms (non-CAFOs) in Wisconsin do not utilize nutrient management plans, and therefore do not get the full environmental, agronomic, and economic benefits that NMPs can provide. It is likely that Kewaunee County's high percentage of land under NMPs has allowed the County to remain at or below the state average for nitrate contamination.

Every CAFO is statutorily obligated to comply with its Wisconsin Pollutant Discharge Elimination System (WPDES) permit; non-CAFOs are not held to the same regulatory standard. A large proportion of the county's livestock are not housed on a CAFO. In fact, approximately half of the dairy cows in Kewaunee County live on unregulated non-CAFO farms. *See* Pet. Ex. 7 (noting that it is "likely" CAFOs may account for more than 50 percent of the dairy cows in

Kewaunee County). Petitioners' decision to ignore non-CAFOs tips their hand as to what they are really after. If Petitioners were truly concerned about nitrate and bacteria contamination, Petitioners would request that EPA extend its emergency action authority to address the cause of nitrate contamination *wherever* it may be. Instead, Petitioners ask EPA to investigate and take enforcement action against CAFOs even though it cannot be established that CAFOs are the primary source of Kewaunee County's water quality issues. Pet. at 33. Even if it was known that these 15 Kewaunee County CAFOs *were* the source of nitrate and bacteria contamination, that alone is insufficient to rise to the level of emergency action under the SDWA, as discussed in Section I., above.

III. The Petition is nothing but a thinly veiled attack on DNR's EPA-approved WPDES CAFO permit program.

The CAFOs that are the subject of this Petition are all operating their farms pursuant to a WPDES permit that is administered and enforced by the DNR. Wis. Admin. Code § NR 243.11. Pursuant to the Clean Water Act, EPA has determined that DNR's WPDES permit program for CAFOs meets the requirements of the Clean Water Act and, as a result, has authorized DNR to administer the WPDES program in Wisconsin. The crux of Petitioners' complaint is really that DNR's WPDES CAFO permit program is inadequate and Petitioners even explicitly request EPA's review as to "whether Wisconsin's nutrient management standards and practices are sufficient to protect groundwater from contamination in areas of karst topography and shallow depth to bedrock and/or groundwater, such as are present in Kewaunee County." Pet. at 34. A SDWA emergency action petition against 15 specific CAFOs is an inappropriate vehicle for Petitioners to attempt to address their concerns with the adequacy of the WPDES permit program, and EPA's delegation of authority related to the same.

A. <u>EPA has delegated its authority over CAFO permitting to DNR</u>

The Wisconsin Supreme Court recently conducted a detailed review of Wisconsin's WPDES permit program, its connection to the federal Clean Water Act and EPA's role in approving and supervising Wisconsin's WPDES program. *Andersen v. Dep't of Natural Resources*, 2011 WI 19, 332 Wis. 2d 41, 796 N.W.2d 1. Pursuant to the Clean Water Act, EPA has authorized DNR to administer a National Pollutant Discharge Elimination System ("NPDES") permit program known as the WPDES Permit Program. *Andersen*, ¶¶ 36-37. The significance of EPA's delegation of authority, which has been entirely ignored by Petitioners, cannot be overstated.

EPA will only approve a state's counterpart NPDES program if it determines that the program provides "adequate authority . . . for the state to issue permits which apply, and insure compliance with, the requirements of the Clean Water Act and" related federal law. *Id.* ¶ 36; *see also Ohio Valley Envtl. Coalition v. Horinko*, 279 F. Supp. 2d 732, 738-39 (S.D. W. Va. 2003) (noting that EPA will only approve a state program "if the State's policy and procedures are consistent with the minimum federal standards"); *Northwest Envtl. Advocates v. EPA*, 268 F. Supp. 2d 1255 (D. Or. 2003) ("The CWA mandates EPA to confirm that state submissions are consistent with applicable CWA requirements."); Wis. Stat. § 283.001(2) (authorizing DNR "to establish, administer and maintain a state pollutant discharge elimination system . . . consistent with all the requirements of the federal water pollution control act"). By authorizing Wisconsin to administer and enforce a state counterpart NPDES program, EPA has recognized that Wis. Stat. chs. 281 and 283 and related implementing regulations, including Wis. Admin. Code chs. NR 108, NR 140, NR 205 and NR 243, are consistent with and meet the substantive and procedural requirements of federal law.

B. <u>EPA monitors Wisconsin's WPDES Permit Program and retains enforcement authority</u>

EPA continues to monitor DNR's compliance with the NPDES program. *Andersen*, ¶ 38 (noting that "even when a state obtains approval to administer its own permit program, the EPA retains significant authority through its continuing oversight of the state's permit program"); *see also City of Ames v. Reilly*, 986 F.2d 253, 254 (8th Cir. 1993) ("Under the [Clean Water] Act, the EPA may authorize states to create and administer their own NPDES permit system, over which the EPA then maintains a watchful eye."); *Delaware County Safe Drinking Water Coalition v. McGinty*, Civ. No. 07-1782, 2007 WL 2213516, *4 (E.D. Pa. July 31, 2007) ("State-approved NPDES programs are subject to continued EPA oversight. The state NPDES program must comply at all times with the requirements of [33 U.S.C.] § 1342(b) and with the federal guidelines promulgated pursuant to [33 U.S.C.] § 1314(i)(2) for monitoring, reporting and enforcement of the NPDES.") If a state permitting program "no longer complies with the requirements of . . . the Clean Water Act," EPA "has the authority to withdraw its approval of [the] state's permit program." *Andersen*, ¶ 39.

Pursuant to 33 U.S.C. § 1342(d) and 40 C.F.R. § 123.44, EPA maintains the authority to review and comment on each individual permit a state proposes to issue in order to ensure compliance with the Clean Water Act. *Andersen*, ¶ 40 (noting that "the state must provide notice to the EPA of every action related to the consideration of [each] permit application including each permit proposed to be issued by such state"). If EPA objects to a particular permit, DNR may not issue it. 33 U.S.C. § 1342(d)(2). It is DNR's practice to send the proposed draft of WPDES permits, including CAFO permits, to USEPA for the agency's consideration. If EPA does not object to a permit's issuance, the appropriate presumption is that the permit is consistent with the Clean Water Act. In fact, the *Andersen* Court concluded that "by approving the

WPDES permit program and by failing to object to the [individual permit at issue in that case], the EPA *effectively determined that the permit complies* with" the specific Clean Water Act regulations that formed the basis of the citizen-petitioners' permit challenge. *Andersen*, ¶ 63 (emphasis added).

C. <u>The Kewaunee County CAFOs all hold WPDES permits and DNR-approved NMPs.</u>

The CAFOs at issue here are all operating their farms in each case pursuant to a WPDES permit that has been reviewed and not objected to by EPA and that is administered and enforced by the DNR. Wis. Admin. Code § NR 243.11. Chapter NR 243 regulates discharges to surface waters and *groundwater* from CAFOs and was promulgated by DNR pursuant to Wis. Stat. chs. 281 and 283 in order to "implement design standards and accepted management practices and to establish permit requirements and the basis for issuing permits to CAFOs." Wis. Admin. Code § NR 243.01(1).

DNR reviews the plans and specifications for each and every "reviewable facility or system" on any CAFO. This means that DNR reviews, and either approves, conditionally approves or rejects the proposed design standards and specifications for manure storage facilities, any structure or system associated with the storage, containment, treatment or handling of manure or process wastewater, permanent spray irrigation or other land application systems, and groundwater monitoring systems at every permitted CAFO in the State of Wisconsin. *See* Wis. Admin. Code §§ NR 243.15; NR 243.03(56). Further, DNR may require in its written approval of the plans and specifications that the design standards in NR 243 be "superseded by more stringent operational or design requirements or practices, based on site-specific conditions" including 1) the physical location of the facilities, including depth to groundwater and bedrock, 2) soil limitations such as permeability and infiltration rate, 3) volume and water content of waste material, 4) available storage capacity and method of application, and 5) "additional requirements or practices necessary to prevent exceedance of groundwater or surface water quality standards or impairments to wetland functional values." Wis. Admin. Code § NR 243.15(1)(d); *see also* Wis. Admin. Code § NR 243.14(10) (imposing additional restrictions on WPDES permittee in excess of Wis. Admin. Code § NR 243).

DNR has authority to enforce a livestock facility's compliance with its WPDES permit; failure to comply with the requirements of a WPDES permit constitutes a violation of that permit, subjecting the permit holder to state enforcement action. Moreover, permitted CAFOs in Wisconsin must comply with the state's groundwater quality standards. *See* Wis. Admin. Code § NR 243.13(1) (requires that discharges from a CAFO production area must comply with "surface water and groundwater quality standards contained in chs. NR 102 to 105, 140 and 207."); *see also* Wis. Admin. Code § NR 243.15(1)(d).

Contrary to Petitioners' claim that CAFOs are incentivized to "land apply beyond agronomic rates",[8] WPDES permits require that a nutrient management plan ("NMP") be prepared by a qualified nutrient management planner, submitted to DNR for review and approval, and updated annually. Wis. Admin. Code § NR 243.14(1). The NMP must outline "the amounts, timing, locations, methods and other aspects regarding the land application of manure and process wastewater." *Id.* All "land application practices identified in the nutrient management plan shall, at a minimum, conform with the nutrient budgeting, soil test recommendations, application practices and restrictions contained in NRCS Standard 590." *Id.* NRCS 590 outlines the requirements for "managing the amount, source, placement, form and

[8] Petitioners argue that "the large quantities of manure generated create an incentive for CAFO owners to land apply beyond agronomic rates." (Pet. at 16.) In support of this bold claim, Petitioners cite two media reports on manure irrigation. These articles contain some examples of over application by out-of-state CAFOs, but no examples or research about over application in Wisconsin, let alone Kewaunee County or at these specific CAFOs.

timing of the application of nutrients and soil amendments" with a purpose of, among other things, minimizing "nutrient entry into surface water, groundwater, and atmospheric resources while maintaining and improving the physical, chemical, and biological condition of the soil." *See* NRCS-WI, 590. Similarly, every permitted CAFO must establish that its manure storage and containment facilities are designed and constructed in accordance with NRCS Standard 313 (for facilities constructed after July 1, 2007). *See* NRCS-WI, 313 and Wis. Admin. Code § NR 243.15. These NRCS technical standards are incorporated by reference into NR 243 (see Wis. Admin. Code § NR 243.07) and are enforceable as a matter of law. A WPDES permit will not be issued until DNR has evaluated the permittee's NMP and determined whether the NMP complies with NRCS 590, in addition to NR 243, pursuant to the authority granted to the DNR under Wis. Stat. chs. 281 and 283.

D. Petitioners do not allege the Kewaunee County CAFOs have violated their permits

Petitioners do not allege that any of the Kewaunee County CAFOs have violated their WPDES permits and Petitioners cannot challenge the adequacy or sufficiency of the issued WPDES permits. *See Coon v. Willet Dairy, LP*, 02-CV-1195, 04-CV-917, 2007 U.S. Dist. LEXIS 51718 (N.D.N.Y. July 17, 2007), *aff'd*, 536 F.3d 171, 174 (2d Cir. 2008) ("*Willet Dairy*"). The "permit shield" language of 33 U.S.C. § 1342(k) protects a Clean Water Act permit-holder from facing suits challenging the adequacy of its permit. See *Atl. States Legal Found., Inc. v. Eastman Kodak Co.*, 12 F.3d 353, 357 (2d Cir. 1993) (quotation omitted). "Therefore, compliance with a NPDES or SPDES permit constitutes compliance with the CWA." *Willet Dairy*, at *12 (citing *Atl. States Legal Found., Inc. v. Eastman Kodak Co.*, 12 F.3d 353 (2d Cir. 1993). In order to bring a Clean Water Act citizen suit, Petitioners would need to assert, among other things, that there have been a violation of "CWA's effluent standards or limitations

-- in other words for violation of permit terms." *Id.* (citing *Swartz v. Beach,* 229 F. Supp. 2d 1239, 1268-69 (D. Wyo. 2002); *cf. Atl. States,* 12 F.3d at 357 ("'The purpose of [Section 402(k)] seems to be . . . to relieve [permit holders] of having to litigate in an enforcement action the question whether their permits are sufficiently strict.'" (quotation omitted)). But petitioners cannot make such assertions. Instead, they seek EPA emergency action under SDWA, RCRA and CERCLA, which is nothing more than an obvious attempted collateral attack on Wisconsin's EPA-approved WPDES CAFO permit program.

IV. <u>Petition does not confer RCRA or CERCLA jurisdiction</u>

In addition to Petitioners' request that EPA assert its SDWA emergency authority, Petitioners also seek EPA's action pursuant to two more federal environmental statutes, CERCLA and RCRA. Under both RCRA and CERCLA, Petitioners request that EPA "investigate, monitor, remediate and abate the imminent and substantial endangerment to public health in Kewaunee County ... and hold those responsible for such endangerment accountable." Pet. at 34. According to Petitioners, CERCLA and RCRA provide EPA with additional supplemental authority that "once invoked and applied by EPA, will facilitate a more comprehensive and effective response to the groundwater contamination in Kewaunee County." *Id.*

The Petitioners assert that the nitrate and bacteria in Kewaunee County's groundwater is a sufficient threat to cause EPA to use its authority to order, among other things, "environmental assessments, controls on future operations, and, potentially, environmental restoration." Pet. at 36. Petitioners cite to the similar efforts in the Yakima Valley matter as authority for EPA to address nitrate and bacteria contamination in groundwater from agricultural sources. However, Petitioners fail to provide evidence of a specific release or threat of release from the identified

CAFOs that would establish CERCLA or RCRA jurisdiction, and they fail to distinguish how applying RCRA would not be duplicate authority already present under the Clean Water Act.

A. Petition does not establish CERCLA response authority

CERCLA gives EPA the authority to take certain actions if the agency determines such actions are necessary to protect the public health, welfare, or environment from a "release or substantial threat of release into the environment of any pollutant or contaminant which may present an imminent and substantial endangerment to the public health or welfare." 42 U.S.C. § 9604(a)(1).

Petitioners' argument for CERCLA jurisdiction relies on EPA's use of CERCLA to address groundwater contamination in Yakima Valley. Pet. at 35. However, in Yakima Valley EPA found CERCLA jurisdiction based on very fact specific issues, and those facts and findings are not the case here. Pet. Ex. 46, at 4-6. The Petition relies on sampling that does not follow EPA procedures and disproportionately focuses on only two of the fourteen towns and villages in Kewaunee County.

To establish a "threat of release" in Kewaunee County, Petitioners merely point to the use of manure lagoons and the land spreading activities of CAFOs. However, Petitioners do not provide evidence that these activities create a threat of release. Petitioners state manure lagoons *can* leach nitrates into ground water, but the authority cited merely states that "leaky lagoons" may transport nitrates. Pet. Ex. 19 at 5. Petitioners present no evidence regarding whether the lagoons at these CAFOs are indeed "leaky" or whether their construction quality warrants them a "threat of release." Moreover, to accept Petitioners' logic here would create CERCLA authority over every farm in the country that applies nutrients to its fields or stores nutrients on-site. This is precisely the purpose of the NPDES program, and is certainly beyond Congress' intended scope of CERCLA. This is even more so true in Wisconsin, where DNR exercises regulatory jurisdiction over ground water in addition to navigable surface waters.

Petitioners also fail to acknowledge that the identified CAFOs operate pursuant to EPA approved WPDES permits. Therefore, any release within the limits of the CAFO's WPDES permits is a "federally permitted release" under CERCLA § 101(10)(A), 42 U.S.C. § 9601(10)(A). Federally permitted releases are not subject to CERCLA liability; "the sovereigns' remedy is pursuant to the law governing the permit program, not CERCLA." 42 U.S.C. § 9607(j); *In re Acushnet River & New Bedford Harbor,* 722 F. Supp 893, FN2 (D. Mass 1989) (partially reversed on other grounds). As discussed in Section III(c.), the CAFOs here are governed by the WPDES permit program, therefore, since Petitioners have failed to identify a release or threat of release that would permit CERCLA jurisdiction, any EPA authority over the CAFOs must extend from the Clean Water Act.

B. <u>Manure is not a solid waste under RCRA</u>

Under RCRA, EPA is authorized to bring an enforcement action against any person who is contributing to the handling, storage, transportation or disposal of any solid waste or hazardous waste which may present an imminent and substantial endangerment to health or the environment. 42 U.S.C. § 9604(b). A material is "solid waste" if it is "garbage, refuse" or "other *discarded material.*" 42 U.S.C. § 6903(27) (emphasis added). Material is "discarded" when it is "disposed of, thrown away, or abandoned." *Safe Air for Everyone v. Meyer,* 373 F.3d 1035, 1042 (9th Cir. 2004). The Ninth Circuit has held that agricultural waste, such as manure, is not considered discarded material under RCRA when it is "returned to the soil as fertilizer[] or soil conditioner[]." *Safe Air,* at 1045-46 (*citing* H.R. Rep. No. 94-191(I) at 2 (1976), reprinted in 1976 U.S.C.C.A.N. 6238, 6240).

Only when manure is applied "without regard to crop fertilization needs" has it been found to constitute a solid waste. *See Community Association for Restoration of the Environment, Inc. v. Cow Palace, LLC*, No. 13-CV-3016-TOR (E.D. Wa. Jan. 14, 2015). Here, Petitioners present no information of the over-application of manure nutrients as was presented in *Cow Palace*. Petitioners do not establish that manure from the CAFOs in Kewaunee County has been used in any way other than as a fertilizer or soil conditioner, and the petition fails to provide evidence that manure from these farms will "cause an imminent and substantial danger to public health and the environment." 42 U.S.C. § 6972(a)(B). Moreover, Petitioners themselves acknowledge that they cannot identify the source of any contamination, as required by RCRA. *See* Kate Prengaman, *Wisconsin dairies, environmentalists watching closely after waste ruling*, Yakima Herald.com (Jan. 16, 2015), attached at Ex. 12 (quoting Kimberlee Wright, executive director of Midwest Environmental Advocates: "Under the Resource and Conservation Recovery Act, you have to identify the sources..."). The Petition does not confer RCRA jurisdiction given this lack of information.

C. RCRA Non-Duplication clause precludes action against permitted CAFOs

RCRA includes two "non-duplication" provisions that direct EPA to avoid duplication between RCRA regulation and government regulations under the Clean Water Act and other federal statutes. 42 U.S.C. § 6905(a); 42 U.S.C. § 6905(b). By its own terms, RCRA does not apply to any activity or substance that is subject to the Clean Water Act, except to such extent that the application of RCRA is not inconsistent with the requirements of the Clean Water Act. *Id.* These "non-duplication" provisions of RCRA have been applied by a court to preclude a RCRA citizen suit claim against a CAFO when the RCRA suit was premised on the same activities and substances that the CAFO's permit covered, including the CAFO's handling of manure and other agricultural waste. *See Coon v. Willet Dairy, LP*, 02-CV-1195, 04-CV-917, 2007 U.S. Dist. LEXIS 51718 (N.D.N.Y. July 17, 2007), *aff'd*, 536 F.3d 171, 174 (2d Cir. 2008) ("*Willet Dairy*").

In the *Willet Dairy* decision, the court dismissed a private citizen suit RCRA claim because: 1) the claim was based on the same activities and substances that were already governed by the dairy's Clean Water Act permit; and 2) the dairy was subject to a permit shield under the Clean Water Act, and allowing the claim under RCRA would have interpreted RCRA to be inconsistent with the Clean Water Act permit shield. *Id.*

Here, the non-duplication clause of RCRA precludes EPA from enforcement actions outside the context of the Clean Water Act (and the Kewaunee CAFOs' WPDES permits). The WPDES permitting scheme is an EPA approved regulation designed to address the same risks cited by Petitioners: the contamination of groundwater resources from the application and storage of manure. Petitioners' requested remedies of investigation, monitoring, and remediation at the CAFOs may all be addressed through the WPDES permitting and enforcement process. To allow RCRA jurisdiction to advance the Petitioner's concerns would be inconsistent with the Clean Water Act. See *Greenpeace, Inc. v. Waste Technologies Indus.*, 9 F.3d 1174 (6th Cir. 1993). Therefore, Petitioners requested RCRA remedy also fails because it violates the non-duplication provisions of RCRA.

CONCLUSION

For the reasons contained herein, the Petition does not meet the standards under SDWA, 42 U.S.C. § 300i(a) for emergency action and EPA action under the SDWA, CERCLA or RCRA is not warranted. As a consequence, EPA should refuse to take the action requested by the Petition.

Respectfully submitted on March 18, 2015.

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/s/ *Jeremy Heim*
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E3730 Rockledge Rd.
Algoma, WI 54201

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Heim's Hillcrest Dairy LLC.
E3730 Rockledge Rd.
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/s/ Scott Heim
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/s/ Lee Kinnard
Kinnard Farms, Inc.
E2675 County Road S
Casco, WI 54205

/s/ Rodney Kinnard
Kinnard Farms, Inc.
E2675 County Road S
Casco, WI 54205

/s/ Maureen Kinnard
Kinnard Farms, Inc.
E2675 County Road S
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/s/ Jacqueline Stewart
Kinnard Farms, Inc.
E2675 County Road S
Casco, WI 54205

/s/ David Stewart
Kinnard Farms, Inc.
E2675 County Road S
Casco, WI 54205

/s/ Greg Bethard
Pagel's Ponderosa Dairy
4893 County Road C
Kewaunee, WI 54216

/s/ Kim Kroll
Rolling Hills Dairy Farm
N3265 County Road AB
Luxemburg, WI 54217

/s/ Duke Kroll
Rolling Hills Dairy Farm
N3265 County Road AB
Luxemburg, WI 54217

/s/ Alan Seidl
Seidls Mountain View Dairy
E745 Luxemburg Road
Luxemburg, WI 54217

/s/ Kevin Nysse
Skyline Blue Acres
E612 County Road BB
Denmark, WI 54208

/s/ Glen Stahl
Stahl Farms
E389 Luxemburg Road
Luxemburg, WI 54217

/s/ Steve Stahl
Stahl Bros. Dairy LLC
N7518 Tonet Road
Luxemburg, WI 54217

/s/ Greg Stahl
Stahl Farms
E389 Luxemburg Road
Luxemburg, WI 54217

/s/ Johannes Wakker
Wakker Dairy Farm, Inc.
N2348 Hwy 42
Kewaunee, WI 54216

/s/ Donald Cochart
E2514 County Road S
Casco. WI 54205

/s/ Amber Hewett
Lakeshore Dairy Services, Inc.
E5365 Second Road
Kewaunee, WI 54216

/s/ Simon Hewett
Lakeshore Dairy Services, Inc.
E5365 Second Road
Kewaunee, WI 54216

/s/ Randy Schmidt
S&S Jerseyland Dairy LLC
7900 Old Elm Road
Sturgeon Bay, WI 54235

/s/ Gary Arendt
Arendt Farms
E1553 Rockledge Rd.
Luxemburg, WI 54217

/s/ Randy Hallet
Hallet Dairy Farm LLC
N7173 County Road C
Casco, WI 54205

/s/ Dena Schmidt
S&S Jerseyland Dairy LLC
7900 Old Elm Road
Sturgeon Bay, WI 54235

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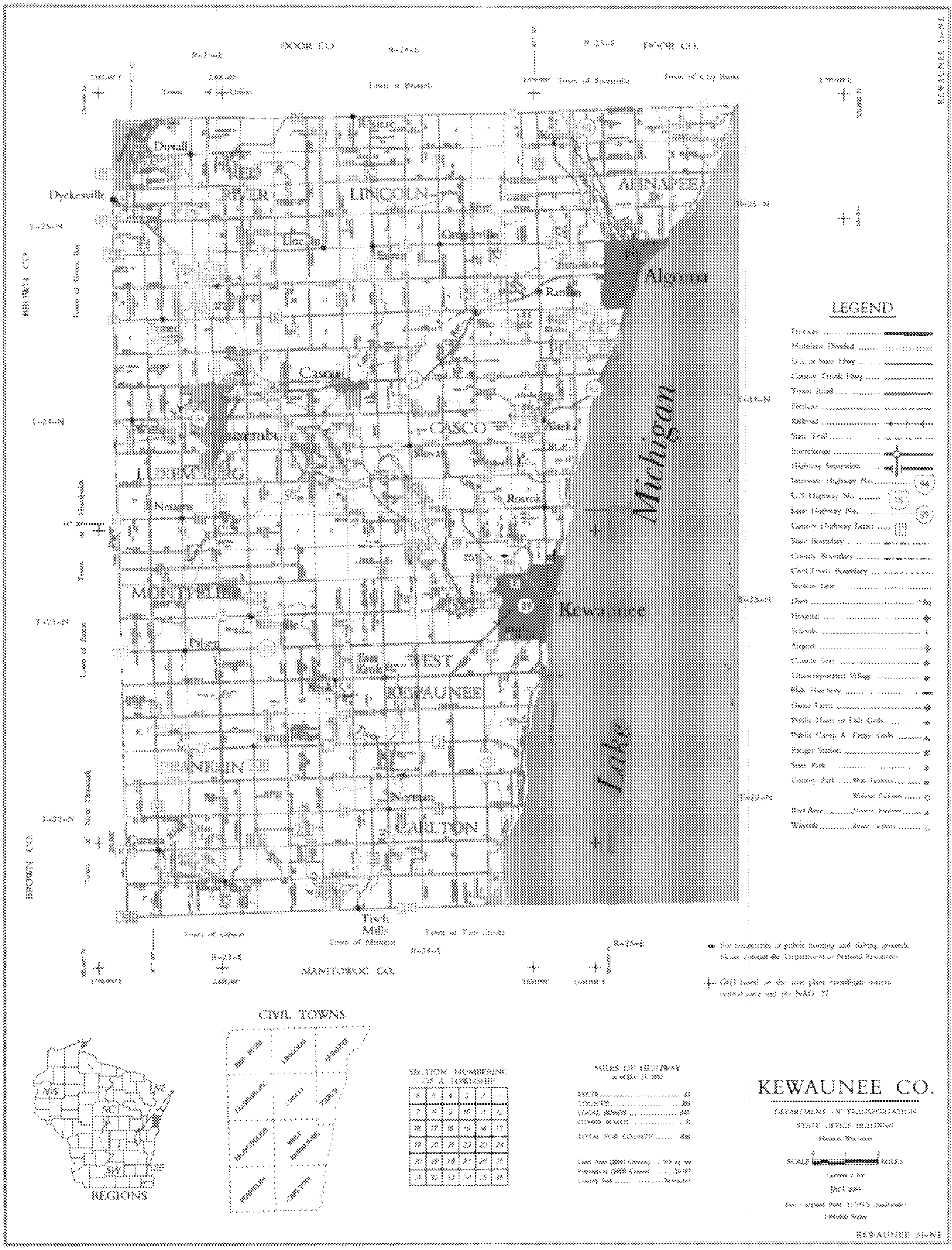
INDEX OF EXHIBITS

Exhibit	Description
1	Map of Kewaunee County
2	Wisconsin Department of Natural Resources Drinking Water Informational Brochure
3	Iowa Statewide Rural Well Water Survey
4	Center for Disease Control Midwestern Well Water Quality Survey
5	Wisconsin Counties Nitrate Exceedance Rates Tied to Cow and Human Density
6	Scottie Dayton, Tanks Look Like Swiss Cheese, Pumper Magazine (Aug. 2008)
7	Septic System Impact on Surface Waters, Tri-State Water Quality Council (June 2005)
8	Wisconsin Department of Natural Resources Drinking Water Data from Three Kewaunee County CAFOs (Dairy Dreams, LLC, Kinnard Farms, Inc. and Pagel's Ponderosa Dairy, LLC)
9	Legislative History of the SDWA, H.R. Rep. No. 93-1185 (1974)
10	Wisconsin Department of Natural Resources Public Water Systems Data for Kewaunee County (Algoma Waterworks, Kewaunee Waterworks and Luxemburg Waterworks)
11	Notice of Final Determination to Reissue a WPDES Permit with Nitrate Controls
12	Kate Prengaman, Wisconsin dairies, environmentalists watching closely after waste ruling, Yakima Herald-Republic (Jan. 16, 2015)

EXHIBIT 1


DOOR CO.
BROWN CO.
MANITOWOC CO.
Duvall
Dyckesville
RED RIVER
LINCOLN
AHNAPEE
Algoma
Casco
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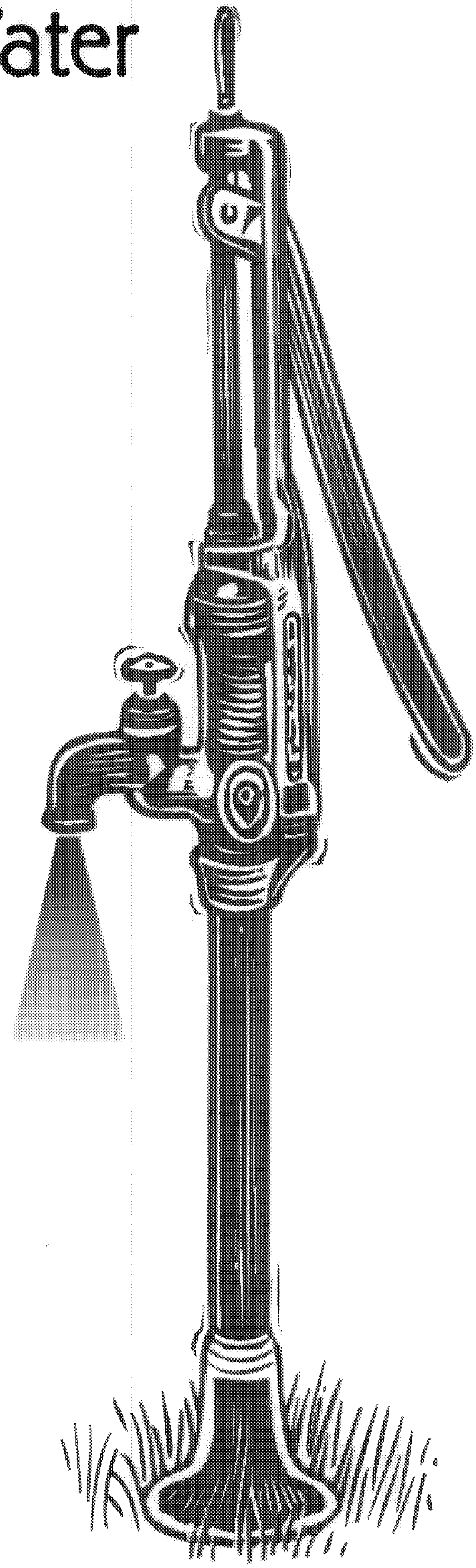
LUXEMBURG
MONTPELIER
Kewaunee
WEST KEWAUNEE
FRANKLIN
CARLTON
Tisch Mills
Michigan
Lake
LEGEND
CIVIL TOWNS
REGIONS
KEWAUNEE CO.

EXHIBIT 2

Wisconsin Department of Natural Resources, Bureau of Drinking Water and Groundwater PUBL-DG-023 2011

Tests for Drinking Water from Private Wells



Why should I test my well?

As one of Wisconsin's 900,000 private well owners or private well water consumers, you probably use groundwater for doing your family's laundry, drinking, cooking, bathing and watering your garden. Municipalities are required to test their water supplies regularly to ensure the water is safe to drink. Since there is no requirement to test a private well except for bacteria when it is first drilled or the pump is changed, you are responsible for making sure your water is safe.

Most private wells provide a clean, safe supply of water; however, contaminants can pollute private wells, and unfortunately you cannot see, smell or taste most of them. Consequently, you should test your water on a regular basis. The decision on what to test your water for should be based on the types of land uses near your well.

This brochure gives information about several common contaminants found in private wells. It should help you decide when to sample your well and how often, how to find a certified laboratory and how to get more information.

What tests should be done on my water?

Total Coliform Bacteria and E.coli

Coliform bacteria live in soil, on vegetation and in surface water. Coliform bacteria found in the intestines of warm-blooded animals and their feces are called E.coli. Some strains of coliform bacteria can survive for long periods in soil and water and can be carried into well casings by insects. Bacteria washed into the ground by rainwater or snowmelt are usually filtered out as the water seeps through the soil, but they sometimes enter water supplies through cracks in well casings, poorly-sealed caps, fractures in the underlying bedrock, and runoff into sinkholes. Coliform bacteria are the most common contaminants found in private water systems. A 1994 Wisconsin survey found them in 23% of the wells tested and E.coli in 2.4% of the wells.

Most coliform bacteria do not cause illness, but indicate a breach in the water system. However, since E.coli bacteria are found in fecal material, they are often present with bacteria, viruses and parasites that can cause flu-like symptoms such as nausea, vomiting, fever and diarrhea. Private wells should be tested at least once a year for bacteria, by a laboratory that performs an E.coli test when total coliform are present. Test again if there is a change in the taste, color, odor or appearance of your water.

The coliform test is one of the most important tests you should have done on your well water. However, bacteria are only one of many possible contaminants. A negative bacteria test is good news, but does not mean your well is free of other contaminants.

Nuisance bacteria

Iron and sulfur bacteria may also be present in well water. Although these organisms do not pose a health threat, they can affect the taste, odor and appearance of water. You may have a nuisance bacteria problem if your water has a rotten egg smell or if you notice slime in the toilet tank. If you suspect a nuisance bacteria problem, try disinfecting the well and water system before testing for iron or sulfur bacteria.

Nitrate

Nitrate forms when nitrogen from fertilizers, animal wastes, septic systems, municipal sewage sludge, decaying plants and other sources combines with oxygenated water.

In infants under six months of age, nitrate exposure can cause a serious condition called methemoglobinemia or "blue-baby syndrome." Infants with this condition need immediate medical care because it can lead to coma and death. Nitrate taken in by pregnant women may reduce the amount of oxygen available to the growing fetus. Test for nitrate if a pregnant woman or infant will be drinking the water.

Everyone should have their water tested for nitrate at least once. If you live in an area within ¼ mile of a corn, soybean or vegetable field, you should test your water for nitrate regularly. Well owners should also test for nitrate regularly if their well is located near an area where fertilizers are manufactured or handled, or an animal feed lot or manure-storage area. In general, shallow wells and wells with short or cracked casings have the highest risk of contamination; however, deep wells are also at risk in some areas. A 2007 random survey of Wisconsin domestic wells found nitrate above the 10 parts per million (ppm) standard in 14% of the wells. Forty-eight percent had nitrate above 2 ppm.

Pesticides

Pesticides are chemicals used to control "pests" such as weeds and insects. Several pesticides have been found in Wisconsin's groundwater. Some of these have entered groundwater as a result of their use on farm fields. Others have been found in groundwater following spills and improper disposal. Long-term use of drinking water that contains pesticide residues may increase your risk of developing cancer or other serious health problems.

If your well is located within ¼ mile of a corn, soybean or vegetable field, you should test your well water for pesticides. You should also consider a pesticide test if your well is within ¼ mile of an area where pesticides are manufactured, stored, mixed or loaded into application equipment. Well owners who are uncertain about the use of pesticides in their area may also want to consider having their water tested at least once.

The most common pesticide found above health-based standards in Wisconsin's groundwater is atrazine, which is used to control weeds in corn crops. An atrazine "screen," which costs around $25, is generally a good first indicator of pesticide contamination in wells that are located near cornfields. In a 2007 random survey of Wisconsin domestic wells, 12% had atrazine present and 1% had atrazine above the drinking water standard.

Well owners who want their wells tested for other pesticides should consider a more comprehensive test. Although a comprehensive pesticide test is more expensive than a "screen," it is also more accurate and is able to detect other pesticides if they are present.

Lead

Lead was a component of plumbing solder that was used in homes with copper plumbing installed before 1985. It has also been used in brass fixtures. When water is naturally soft or acidic, lead can leach from solder or brass into drinking water. Wells located near existing or former cherry orchards in Door County may also contain lead, due to historical use of lead arsenate pesticides.

Chronic exposure to lead can damage the brain, kidneys, nervous system, and red blood cells. Preschool-aged children are particularly sensitive to the toxic effects of lead. Exposure during pregnancy can affect the developing fetus.

Copper

Copper is present in plumbing lines in most households. Homes that have new copper plumbing or a naturally soft water supply are more likely to have copper-contaminated water. Symptoms caused by excessive copper exposure include stomach upsets, abdominal cramping, diarrhea and headaches. Because copper is also very toxic to fish, avoid using water containing high levels of copper to fill aquariums.

Lead and Copper Testing

Testing for lead and copper should be done on "first draw" water that has been stagnant in the distribution pipes for at least six hours. If lead and copper levels are high due to plumbing, they can usually be reduced to acceptable levels by flushing the faucet for a minute or two before collecting water for drinking. This method is not effective in large buildings and when the source of the lead or copper is distribution lines located outside the home.

Solvents, gasoline, and fuel oil

Household and industrial solvents, gasoline and fuel oil are examples of volatile organic chemicals or VOCs. Some VOCs are relatively non-toxic, while others can cause cancer, birth defects and reproductive problems.

Fuel oil and gasoline can enter groundwater as a result of a leaking storage tank or spill. Wells that are located within ¼ mile of an active or abandoned gasoline station, home or farm fuel tank or bulk storage tank have about a 25% chance of being contaminated and should be tested at least once for pVOCs (VOCs from petroleum products).

Paint thinners, dry cleaning chemicals and industrial solvents can enter groundwater from spills, improper disposal, leaking storage tanks and landfills. Wells that are located within ¼ mile of a landfill, dry cleaner, auto repair shop or industrial site where solvents have been used should be tested for VOCs. Because solvents, gasoline and fuel oil are common in our environment, all owners of private wells should consider having their water tested for VOCs at least once.

If you notice a solvent-like or gasoline taste or odor in your water, you should use an alternate, safe source of drinking water until your water can be tested for VOCs.

PCBs

PCBs (polychlorinated biphenyls) are suspected cancer-causing agents that were manufactured and used between 1930 and 1979. Some submersible well pumps that were built before 1979 contain PCB-containing oils and have the potential to release PCBs and contaminate drinking water supplies if they fail.

If your well has a submersible pump that was installed before 1979, you should contact a licensed pump installer to help you determine whether it contains PCBs. If you notice an oily sheen or petroleum odor in the water, switch to an alternate, safe source of drinking water and call a pump installer for assistance.

Minerals and radioactivity

In some regions of Wisconsin, groundwater contains high levels of toxic minerals and radioactivity. The location and depth of your well determine its susceptibility to these contaminants.

Arsenic

Arsenic occurs at low levels in soil and bedrock, but has been found at levels above drinking water standards in wells in all areas of the state, especially in northeastern Wisconsin. Arsenic also may occur in wells near landfills that received paint or electronic components. Exposure to arsenic at high levels can result in nervous and digestive system problems. Long-term exposure to arsenic has been linked to skin and other cancers.

Because arsenic has been found in wells across the state in various geologic formations, and the test is relatively cheap, every well owner should have their water tested at least once for arsenic.

Radium

Radium is a radioactive element found in soil and bedrock that can be released into groundwater. Radium levels above the drinking water standard have been detected in eastern and west central Wisconsin where wells draw water from deep sandstone formations, and in a few areas of northern Wisconsin where wells are constructed into granite. Exposure to high levels of radium over a period of several years can increase your risk of developing bone cancer. Consult DNR on whether to test for radium.

Boron

Boron is often present in groundwater and foods at low levels. High levels of boron can enter groundwater from landfills or other sites where fly ash has been deposited. Long-term exposure to boron can cause reproductive and developmental problems. Wells located within ¼ mile of a fly ash landfill should be tested for boron.

Radon

Radon is a colorless, odorless soil gas that can enter homes through cracks in the foundation. Radon can also be present in groundwater and may escape into your home from your water supply. Deep bedrock wells are more susceptible. Breathing air that contains radon can significantly increase your chance of developing lung cancer.

If you live in a newer, energy-efficient home or have a floor in your basement or crawl space that is dirt or is not completely sealed, you should test the air in your home. Because only a small portion of the radon gas found in a home comes from the water supply, it is not necessary to test your water unless other remedies fail to reduce radon levels in the air.

Fluoride

Water consumed by infants and preschool-aged children should be tested for fluoride. Discuss your test result with your child's doctor or dentist to decide whether he/she needs fluoride supplements. You may be advised to switch to an alternate source of water for drinking if the fluoride concentration exceeds 4 parts per million.

How can I have my well tested?

Laboratories

Use a certified laboratory to test your drinking water for possible contaminants. Labs that test for bacteria in water are certified by the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) and can be found online at: **dnr.wi.gov/org/water/dwg/PrivateLabs.pdf**. Labs that test for contaminants such as nitrate, pesticides, metals, and VOCs are certified by the Wisconsin Department of Natural Resources (DNR) and can be found online at: online at: **dnr.wi.gov/org/es/science/lc/PW/Lablists.htm**. Laboratories are also listed in the business pages of your telephone directory under "Laboratories – Testing."

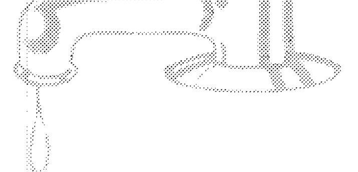
When you call a laboratory, ask if the lab is certified for the test you want. When your test has been completed, the laboratory will send you the results directly. If a Wisconsin Unique Well Number (WUWN) has been assigned to your well, you may choose to have a copy of your test results stored in a permanent file for your well by writing the WUWN on the lab form and checking the box "send copy of results to DNR." Results of water quality tests done by the State Laboratory of Hygiene are automatically reported to DNR for filing. You can find your Unique Well Number close to the sampling faucet on the water pipe entering the building from the well or on the main electrical fuse box.

Sample Collection

Water collection procedures vary depending on the type of test being done. Samples for some tests can be collected easily, while others may require a drinking water professional to collect the sample. For a reliable test result, follow the laboratory instructions exactly.

Home Water Testing Kits

"Do-it-yourself" drinking water test kits are available from building supply, hardware, and discount stores. However, there is no kit that can fully evaluate the safety of drinking water. Many kits only inform whether or not a substance is present above drinking water standards, without providing the concentration. Other kits only detect a narrow range of compounds, while missing others. Well owners should check expiration dates, ask questions about the sensitivity and accuracy of the test kit, and follow up with a test by a certified laboratory. Home water testing kits may be a useful first step, but rely on certified laboratories for complete peace of mind.

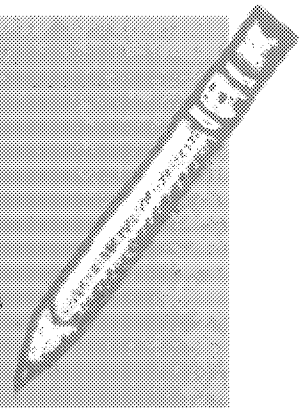


Private Well Testing Recommendations

Contaminant	Which wells or homes should be tested?	How often should I test?
Coliform Bacteria	Every well	Test once every year, or when there is a change in taste, color or odor
Nitrate	All newly-constructed wells or wells with no testing history	Two tests spaced six months apart
	Wells within ¼ mile of fertilized fields or animal feed lots	Test annually
	Wells used by pregnant women and infants	Test before pregnancy and at time of birth
	Wells that had levels close to 10 ppm	Test annually
Pesticides	Wells within ¼ mile of agricultural fields, or pesticide manufacturing, storage or mixing facilities	Test once every 5–10 years
Lead	Homes with copper plumbing installed before 1985 or brass fixtures, and naturally-soft water	Consider one time test
	Wells near Door County cherry orchards	Consider one time test
Copper	Water used to prepare infant formula or if any resident in-home experiences repeated symptoms of nausea, diarrhea or abdominal cramps. Homes most at risk have new copper plumbing or naturally-soft water.	Test before and after flushing the faucet for 2 to 3 minutes Homes with new copper plumbing should be retested in 6 months
VOCs (solvents, gasoline or fuel oil)	Wells within ¼ mile of a landfill, underground fuel or gasoline tank and wells within ¼ mile of where solvents have been used (Drycleaner, automotive garage or body shop, etc)	Test once every 5–10 years or when solvent or gasoline taste or odor is noticed
PCBs	Water with an oily sheen or petroleum odor, and submersible pump installed before 1979	Test once if needed
Arsenic	Every well	Test once Test annually if arsenic is present Retest if iron levels increase or if water changes in taste or odor
Radium	Wells in specific areas of Wisconsin	Consult with DNR or UW Extension on whether to test
Boron	Wells within ¼ mile of fly ash landfill	Test once every 5–10 years
Radon	Homes with high radon levels in the air that are not reduced by sealing basement cracks and ventilation	Test once if needed
Fluoride	Wells used by infants and preschool-aged children	Test when infant is born

How can I get more information?

The following DNR brochures can provide you with more information. They are available from DNR offices and may be available from: county Extension offices; local sanitary, zoning or health department offices; or from licensed well drillers and pump installers. They are also available on the DNR website at: dnr.wi.gov/org/water/dwg/priwellp.



Arsenic in Drinking Water
Bacteriological Contamination of Drinking Water
Copper in Drinking Water
Earwigs in Your Well
Iron in Drinking Water
Iron Bacteria Problems in Wells
Lead in Drinking Water
Nitrate in Drinking Water
Pesticides in Drinking Water
Radium in Drinking Water
Radon in Drinking Water
Restoring Drinking Water—State Funds for Replacing Contaminated Wells
Sulfur Bacteria Problems in Wells
Volatile Organic Chemicals in Drinking Water

UW Extension has several drinking water brochures available at: **uwsp.edu/cnr/gndwater/privatewells.index**. Click on "Water Quality" under the "Natural Resources" drop-down menu.

Topics and Contacts

- ✔ Interpreting Test Results
  - ❐ Certified laboratories
  - ❐ DNR website
  - ❐ UW Extension website
  - ❐ County health departments
  - ❐ Wisconsin Division of Public Health
- ✔ Pesticides
  - ❐ Wisconsin Department of Agriculture, Trade and Consumer Protection
  - ❐ Wisconsin Division of Public Health
- ✔ Pump Installation
  - ❐ Licensed pump installers
  - ❐ Licensed well drillers
- ✔ Radon
  - ❐ Wisconsin Radiation Protection Council
  - ❐ Wisconsin Division of Public Health
- ✔ Water Treatment Options
  - ❐ Licensed plumbers
  - ❐ Wisconsin Department of Commerce
- ✔ Bottled water quality
  - ❐ Wisconsin Department of Agriculture, Trade and Consumer Protection

This brochure was revised by the Wisconsin Department of Natural Resources with assistance from the Education Subcommittee of the Groundwater Coordinating Council.

EXHIBIT 3

Iowa Statewide Rural Well Water Survey

Increased concern for water quality has substantially increased the research and monitoring of water quality in Iowa. Several water quality monitoring surveys have been conducted in Iowa, including watershed-specific, county-specific, and statewide surveys.

These surveys have greatly clarified the type, concentration, and distribution of contaminants in Iowa water supplies. This publication summarizes preliminary results of the Iowa Statewide Rural Well Water Survey. This survey is unique because it is the first statewide assessment of water quality in rural, private wells.

The Iowa Statewide Rural Well Water Survey was designed and conducted by the Iowa Department of Natural Resources Geological Survey Bureau and the University of Iowa Center for Health Effects of Environmental Contamination.

Systematic sampling of 686 rural wells was conducted during 1988 and 1989. The survey sample was based on rural population density and covered all of Iowa's 99 counties. Water samples were analyzed for coliform bacteria, nitrate, 27 pesticides, several pesticide breakdown products, and various other elements.

The survey also included a questionnaire and site evaluation that determined well characteristics, potential point sources of chemicals, agriculture chemical use and practices, and existing health symptoms or conditions. Preliminary results were released in February 1990; complete analysis of the results is expected within one to two years.

Total Coliform Bacteria Detection in Private Wells

A greater percent of private wells were unsafe because of total coliform bacteria than any other contaminant; 44.6 percent of the private wells tested were considered unsafe (table 1). Coliform bacteria are not a health concern in themselves, but are an indication that other disease-causing microorganisms may be able to enter the water system. For that reason, the presence of coliform bacteria is considered unsafe.

The highest percent of wells considered unsafe due to coliform bacteria were in western and southern Iowa (figure 1). The highest percent of unsafe wells was found in southwest Iowa (66.6 percent), followed by southeast (62.3 percent), northwest (60.1 percent), and central Iowa (58.4 percent). In contrast, the lowest percent of wells that had unsafe bacteria levels was in northeast Iowa where 20.2 percent tested unsafe.

Well depth was a significant factor with respect to contamination from total coliform bacteria. For wells less than 50-feet deep, 71.5 percent con-

Table 1. The Iowa Statewide Rural Well Water Survey: private wells exceeding drinking water standards or guidelines for bacteria, nitrates, and herbicides. Source: Iowa Department of Natural Resources and the University of Iowa, 1990.

Contaminant	Percent of Private Wells Sampled
Total Coliform Bacteria: **unsafe wells**	44.6
Nitrate-Nitrogen: wells **exceeding** 10 ppm	18.3
Herbicides: wells **exceeding** lifetime health advisory levels	1.2

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tained coliform bacteria. Wells deeper than 50 feet were less vulnerable to bacterial contamination — 36.3 percent of these wells were unsafe.

Nitrate-Nitrogen Detection in Private Wells

Nitrate-nitrogen concentrations exceeded the 10 parts per million (ppm) drinking water standard in 18.3 percent of the private wells tested (table 1). The distribution of wells exceeding the drinking water stand ard for nitrate-nitrogen are given in figure 2.

Similar to the distribution of wells with unsafe bacteria levels, the highest percent of wells exceeding the nitrate-nitrogen drinking water standard were in northwest (32.3 percent), southwest (32.2 percent), and southeast Iowa (26.5 percent). The lowest percent of wells exceeding the standard was found in north central Iowa (3.8 percent) followed by east central Iowa (7.0 percent).

Mean nitrate-nitrogen concentrations averaged 6.2 ppm statewide. Both southwest (11.3 ppm) and northwest Iowa (10.9 ppm) had mean nitrate-nitrogen concentrations that exceeded the drinking water standard. The lowest mean nitrate-nitrogen concentration was in north central Iowa (2.5 ppm).

As with bacteria, well depth was an important factor influencing wells exceeding the nitrate-nitrogen drinking water standard. For wells less than 50-feet deep, 35.1 percent exceeded the 10 ppm nitrate-nitrogen standard. In contrast, 12.8 percent of the wells greater than 50-feet deep exceeded the nitrate drinking water standard.

Pesticide Detection in Private Wells

Pesticides were detected in 13.6 percent of the 686 rural, private wells tested in this survey. Nearly all of these detections were herbicides (table 2). Drinking water health advisory levels for commonly used pesticides are listed in table 3.

Table 2. Summary of pesticide detections for the 1990 Statewide Rural Well Water Survey. Source: Iowa Department of Natural Resources and the University of Iowa, 1990.

Pesticide	Private Wells with Detections	Average Concentration	Private Wells Exceeding EPA Lifetime Health Advisory Level
	(% of total)	(ppb)	(% of total)
atrazine	4.4	0.90	0.7
deethyl-atrazine[a]	3.5	0.54	-
deisopropyl-atrazine[a]	3.4	0.68	-
Sencor	1.9	0.16	0
Prowl	1.7	0.19	0
Dual	1.5	0.92	0
Bladex	1.2	0.30	0
Lasso	1.2	0.67	0.3
hydroxy-alachlor[a]	0.4	0.91	-
Tordon	0.6	0.39	0
2,4-D	0.6	0.20	0
DCPA	0.4	0.02	0
Ramrod	0.4	0.11	0
Treflan	0.4	5.65	0.1
Furadan	0		
hydroxy-carbofuran[a]	0. 4	0. 38	-
keto-carbofuran[a]	0. 4	0. 03	-
All others	0		

[a]Environmental breakdown products

Herbicide concentrations in this survey were generally less than 1 part per billion (ppb). No active ingredient of any insecticide was detected. However, two breakdown products of the insecticide Furadan were each detected in 0.4 percent of the 686 private wells sampled.

Only 1.2 percent (eight wells) of the 686 wells tested exceeded Environmental Protection Agency (EPA) lifetime health advisory levels for herbicides (table 1). Atrazine exceeded the 3 ppb EPA lifetime health advisory level in 0.7 percent (five wells) of the 686 sampled.

Three wells exceeded lifetime health advisory levels for herbicides other than atrazine. Lasso exceeded the EPA lifetime health advisory level of 0.4 ppb in 0.3 percent (two wells) of those tested. The maximum Lasso concentration detected was 4.76 ppb. A spill of the formulated Lasso near one of these wells likely contributed to the elevated concentration. Treflan exceeded the EPA lifetime health advisory level of 2 ppb in 0.1 percent (one well) of the total wells sampled. Treflan detection in this well was attributed to a past backsiphoning incident.

Atrazine, the most commonly detected herbicide in this survey, was found in 4.4 percent of the private wells sampled (table 2). Atrazine and/or its breakdown products were detected in a total of 8 percent of the private wells tested.

The distribution of the percent of wells with atrazine detections is shown in figure 3. Northwest Iowa had the highest percent (14.6 percent) of wells with atrazine detections; southeast Iowa had the lowest (6.2 percent). Atrazine detections in other areas were similar, ranging from 7.1 to 8.8 percent.

Several other herbicides were detected in the survey, but none were detected in more than 2 percent of the wells (table 2). The distribution of pesticide detections is shown in figure 4. The lowest percent of wells with pesticide detections was in southeast Iowa (9.3 percent) followed by northeast Iowa (10.9 percent). The highest percent of wells with pesticide detections was in northwest Iowa (22 percent). In contrast to both bacteria and nitrate results, well depth was not a significant factor with respect to pesticide detections, at least when comparing wells less or more than 50 feet in depth.

There are many factors that can influence the movement of pesticides below the root zone. However, one characteristic sets atrazine apart from other herbicides commonly used for weed management in corn. It degrades at a slower rate — a characteristic that has both advantages and disadvantages.

As a benefit, atrazine remains active longer and can control many weeds throughout the season. At the same time, the slower degradation rate of atrazine increases the chance that it may move below the root zone into the lower soil profile.

Preliminary conclusions

The results of this survey should be interpreted with caution, as the survey was conducted during two of the driest years on record. Results may have been considerably different during years with average or above average precipitation.

Secondly, the results are preliminary. Much of the information collected during the survey, which will help interpret the results, is being analyzed.

However, some conclusions can be made. On a regional basis, the Iowa Statewide Rural Well Water Survey indicates wells in western and southern Iowa are the most vulnerable to contamination, primarily because of the dependence on shallow groundwater in these areas.

The high percent of wells with coliform bacteria is related to the large proportion of shallow wells used by rural Iowans. Coliform bacteria is common in the water from shallow wells. Many of these wells are open to the top of the water table, which makes them susceptible to contamination.

The total coliform data may suggest other problems with well location, construction, and/or placement. These factors also may contribute to the nitrate and pesticide detections in rural wells. There is not a good correlation, however, between total coliform occurrence and nitrate and pesticide detections. Additional analysis will help define these relationships.

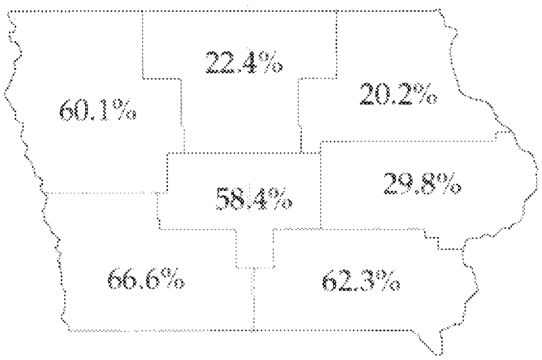

Figure 1. Percent of private wells with unsafe levels of total coliform bacteria. Statewide average: 44.6 percent.

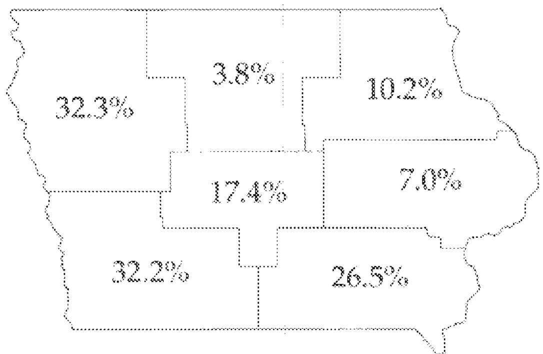

Figure 2. Percent of private wells with detection of nitrate-nitrogen exceeding 10 parts per million. Statewide average: 18.3 percent.

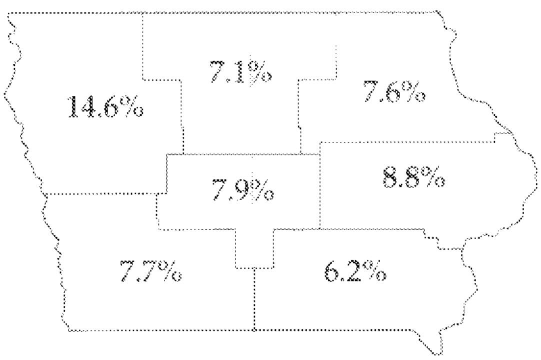

Figure 3. Percent of private wells with detections of atrazine and/or atrazine breakdown products. Statewide average: 8.0 percent.

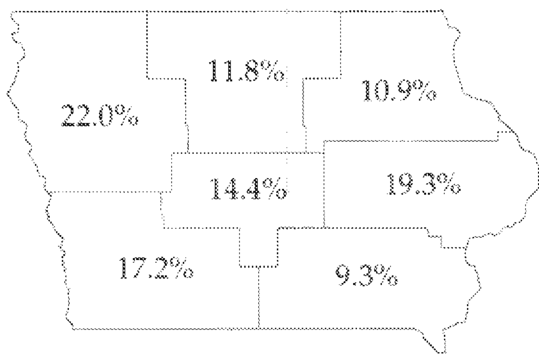

Figure 4. Percent of private wells with detections of pesticide and/or pesticide breakdown products. Statewide average: 13.6 percent.

This survey shows there is a poor correlation between the regional variation in the percent of rural wells with atrazine detection and the regional variation in atrazine use.

For example, northwest Iowa had the highest percent of wells with atrazine detection. However, in the past, northwest Iowa has had one of the lowest percent of corn acres treated with atrazine, as well as a relatively low application rate per acre. This suggests that factors in addition to the atrazine application rate and the number of acres treated with atrazine contribute to its detection in well water.

However, conclusions drawn at the regional level are general. Analysis of results from specific well sites is still necessary.

For atrazine and other pesticides, well depth, construction and placement, the proximity of application to the well, and the proximity of mixing and loading to the well, may be important factors influencing pesticide movement into well water.

Additional information

Additional information on factors influencing pesticide movement to groundwater and surface water, as well as best management practices that minimize pesticide losses, can be found in extension publication Pm-1394, *Pesticide Use and Water Quality in Iowa.* Other related publications include Pm-1389, *Chemical Alternatives to Atrazine In Corn Weed Management Programs;* Pm-1390, *Atrazine Management Rules for Iowa;* Pm-1393, *Banding Herbicides for Row Crop Weed Management;* Pm-1395, *The Iowa Public Water Supply Survey.*

Table 3. Environmental Protection Agency drinking water health advisory levels for commonly used herbicides and insecticides in Iowa.

Common Name	Trade Name	EPA Health Advisory Level[a] 10 Day (ppb)	Lifetime (ppb)
Herbicides:			
acifluorfen	Blazer/Tackle	2,000	--
alachlor	Lasso	100	--
atrazine	AAtrex	100	3
bentazon	Basagran	300	20
butylate	Genate/Sutan	2,000	350
cyanazine	Bladex	100	1
2,4-D	many	300	70
DCPA	Dacthal	80,000	4,000
dicamba	Banvel	300	200
glyphosate	Roundup	20,000	700
metolachlor	Dual	2,000	100
metribuzin	Lexone/Sencor	5,000	200
propachlor	Ramrod	500	90
simazine	Aquazine/Princep	500	4
trifluralin	Treflan	80	5
Insecticides:			
carbaryl	Sevin	1,000	700
carbofuran	Furadan	50	40
fonofos	Dyfonate	20	10
terbufos	Counter	5	0.9

[a]Source: U.S. EPA Office of Water, April 1992

These publications are available at county extension offices in Iowa or from Extension Publications Distribution, 112 Printing and Publications Building, Iowa State University, Ames, Iowa 50011; (515) 294-5247.

Additional information concerning the Iowa Statewide Rural Well Water Survey is available from the Iowa Department of Natural Resources, Wallace State Office Building, Des Moines, Iowa 50319; or call the Groundwater Hotline, 1-800-532-1114.

Reference

Hallberg, G.R. and Kross, B.C. 1990. Iowa Statewide Rural Well Water Survey — Summary of Results. Iowa Department of Natural Resources Geological Survey Bureau and University of Iowa Center for Health Effects of Environmental Contamination. Iowa City, IA, 52242.

Prepared by David Stoltenberg, former extension agronomist, and Marilyn Vaughan, extension communication specialist. Reviewed by Gerald Miller, extension agronomist, and George Hallberg, geologist, Iowa Department of Natural Resources.

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EXHIBIT 4

A Survey of the Quality of Water Drawn from Domestic Wells in Nine Midwest States

Centers for Disease Control and Prevention
National Center for Environmental Health
September 1998

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NCEH 97-0265

To obtain a printed copy, please contact the Emergency Preparedness Response Branch at (770) 488-7100.

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Acknowledgments

The **1994 Midwest Well Water Survey** was funded by United States Public Health Service Office of Emergency Preparedness through the 1993 Midwest Flood Supplemental Appropriations. The funds were granted through the Centers for Disease Control and Prevention to the nine states affected by the floods. Staff members from the organizations listed below designed the survey, collected and analyzed the water samples, and interviewed the well owners. Without their extraordinary efforts and dedication, the survey could not have been completed.

State departments of health:

- Illinois
- Iowa
- Kansas
- Minnesota
- Missouri
- Nebraska
- North Dakota
- South Dakota
- Wisconsin

Supporting Agencies:

- Centers for Disease Control and Prevention
- Department of Energy
- Domestic Policy Council
- Environmental Protection Agency
- Federal Emergency Management Agency
- Flood Recovery Working Group of 1993
- Food and Drug Administration
- Intergovernmental Steering Committee for Long-Range Flood Recovery
- Johns Hopkins University
- The National Governors Association
- Office of Emergency Prepardness, US Public Health Service
- The Orkand Corporation
- United States Department of Agriculture
- United States Geological Survey

Lastly, we thank the families that participated in the survey.

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Executive Summary

Domestic wells, cisterns, or springs supply drinking water to eighteen percent of the households in the nine upper midwestern states. Many of these wells were in areas of the Missouri and Mississippi River basins that were flooded during the 1993 midwest flood. After the flood waters receded, many state and county sanitarians reported that water samples collected from domestic wells in the flooded river basins contained coliform bacteria. Since the nature and magnitude of this contamination was unknown, a survey was initiated to assess the presence of bacteria and chemicals in water drawn from domestic wells in the states that were severely affected by the flood.

The survey was conducted in May to November of 1994 by state health and environmental departments of nine midwestern states with assistance from the Centers for Disease Control and Prevention (CDC). Because samples were collected one year after flooding and few of the sampled wells had preflood water quality results, the effect of this disturbance on the water quality of domestic wells could not be evaluated. Water samples were collected from 5520 households with domestic wells. These houses were near the intersections of a 10 mile grid overlaid on a map of Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin. Samples were usually collected from the household faucet that was used to supply drinking water. Coliform bacteria, *Escherichia coli*, nitrate, and atrazine were measured. The coliform bacteria and *E. coli* serve as indicators of contamination and their presence in water supply systems indicate an increased risk for diarrheal illnesses. Fertilizers and herbicides are intensely applied in rural areas of the Midwest, the location of most domestic wells. Nitrate, a breakdown product of fertilizers, may produce methemoglobinemia (Coomley, 1945). Atrazine, a herbicide, has been classified as a possible human carcinogen (IARC, 1991).

Field personnel collected the water samples and interviewed survey participants on the construction, condition, and maintenance of their well; the potential sources of contamination near the well; the number of people drinking well water; and the occurrence of diarrhea in their household. A sanitary survey was performed to record the condition of the well, the local geography, and to determine the type, distance, and location of potential pollution sources.

A water sample was considered to be contaminated when coliform bacteria or E. coli were present or when nitrate or atrazine concentrations exceeded their maximum contamination level (MCL) established by the Environmental Protection Agency (EPA) for public water systems. Coliform bacteria were present in 41.3% and *E. coli* in 11.1% of the samples. Nitrate was detected in 65.4% of the samples, with 13.4% exceeding their MCL of 10 mg/L NO_3-N. The mean nitrate level was 8.4 mg/L NO_3-N and ranged from not detected to 266 mg/L. Atrazine and structurally related triazines were detected in 13.6% of the samples (mean, 0.4

ppb; range, not detected to 29 ppb), with 0.2 % exceeding the MCL of 3 ppb. Atrazine was not measured in the water samples collected in North Dakota because of its limited use in the state.

Wells in southern Illinois, western Iowa, northern Missouri, and eastern Kansas had a greater proportion of samples with coliform bacteria and E. coli. Elevated nitrate levels were more likely to be found in water samples from western Illinois, Iowa, northern Missouri, eastern Kansas, and southeast Nebraska. Only 9 samples in the survey contained atrazine levels exceeding 3 ppb, and were dispersed throughout the eight states. Samples with atrazine concentrations between the detection limit and 3 ppb were more likely to be from Illinois, Wisconsin, or Kansas.

Wells in this survey were built by drilling (77.0%), digging (10.6%), driving a sandpoint (5.4%), or boring with an auger (3.8%). The mean age of the wells was 27 years (range, less than 1 year to 200 years), the mean depth was 154 feet (range, 1 foot to 3500 feet) and the mean diameter was 10.6 inches (range, 1 inch to 144 inches). Steel or plastic casing was used in 80.3% of the wells. Water samples from households with wells older than 25 years, shallower than 100 feet, or greater than 6 inches in diameter were more likely to have contaminants than samples from households with a newer, deeper, and smaller-diameter drilled or driven well. Water samples from households with bored or dug wells were 10 to 15 times more likely to contain coliform bacteria or *E. coli* than were samples from households with drilled or driven wells.

Well owners reported using pesticides (14.3%), fertilizers (11.4%), and manure (7.8%) within the past 5 years and within 100 feet of the well. The application of these products was associated with the presence of coliform bacteria and *E. coli*, and with nitrate levels above 10 mg/L in the water samples.

The sanitary survey revealed that potential contamination sources were commonly found within 100 feet of the well head. Septic tanks (30.2%) and lateral fields (16.9%), structures that contain human fecal material, were the most common pollution sources. Less than 1% of the wells had a sewage lagoon, silage storage, agricultural drain, or sink hole within 100 feet. One-fourth of the wells not only had a contamination source within 100 feet but were also down gradient from that source.

Pitless adapters provide a seal between the well casing and the distribution system and backflow devices prevent back syphoning of water. Of the wells in the survey, 44.2% had pitless adapters and 20.7% had backflow devices. Wells with these devices had up to 20% fewer contaminated samples than wells lacking these devices. Samples from wells with a crack or hole in the well casing were up to 7 times more likely to be contaminated than were samples from wells with intact casings.

Of the 15,978 people who consumed water from these wells, 2.9% reported a diarrheal episode during the 2 weeks prior to the collection of water samples for this survey. There was no association between the occurrence of diarrheal episodes and the presence of coliform bacteria or E. coli in water samples. The diarrheal rate among participants in the survey (0.75/person/year) was similar to the endemic rate of gastrointestinal illness reported in other surveys in North America (0.66 to 1.6/person/year) (Hodges et al., 1956; Monto and Koopman, 1980; Payment et al., 1991).

In summary, coliform bacteria, *E. coli*, nitrate, and atrazine were found in many of the water samples collected from midwestern households with a domestic well. Most of the water samples with these pollutants were drawn from dug or bored wells that were old and shallow and had a large-diameter brick or concrete casing. People relying on these types of wells for their drinking water should be informed that they are at increased risk to these pollutants. Wells with a pitless adapter or backflow device had a lower contamination rate. A cracked casing or opening in the well greatly increased the risk for contamination. Samples from wells within 100 feet from septic tanks or cisterns; or had pesticides, manure, or fertilizer applied within 100 feet of the well; or down gradient from a pollutant source had a higher contamination rate.

There are 14 million households in the United States that rely on a domestic well to supply their drinking water and over 90,000 new wells drilled each year. The risk of contracting waterborne diseases from domestic well water systems can be reduced by protecting the watershed and aquifer, building wells away from possible contamination sources, properly constructing and maintaining wells and their distribution systems, routinely testing for contaminants, and, if necessary, effectively disinfecting the water. Education should be available to well owners and users, water well drillers, and county and state personnel. With strong, effective programs that address these issues, a domestic well water system can provide potable water that is safe and economical.

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Introduction and Purpose

Domestic water wells supply water to 17.6% of the households in the upper midwestern states (**Table 1**). In the spring of 1993, flood waters covered some of the water wells in the Missouri and Mississippi river basins. River flooding can affect groundwater quality by raising the water table, altering hydraulic gradients, recharging from different areas, or flowing directly down the well casing. Many residents who tested water from their domestic well after the flood waters receded reported the presence of coliform bacteria or *E. coli* in these samples.

TABLE 1.
Sources of drinking water for households in nine Midwestern States

State	Drinking Water Source* (percent)			
	Number of Households	Public	Private	Other
Iowa	1,143,669	81.1	18.4	0.5
Illinois	4,506,275	89.8	09.8	0.4
Kansas	1,044,112	89.5	10.0	0.5
Minnesota	1,848,445	83.7	15.3	1.0
Missouri	2,199,129	73.0	26.2	0.8
Nebraska	660,621	82.9	16.9	0.2
North Dakota	276,340	79.0	19.2	1.8
South Dakota	292,436	81.4	16.7	1.9
Wisconsin	2,055,774	66.5	32.8	0.6
Total	**14,027,611**	**81.8**	**17.6**	**0.6**
US	***102,263,678***	***84.2***	***14.8***	***1.0***

*The US Census defines a public water source as one that provides water for five or more houses, apartments, or mobile homes and a private water source as one that provides water for four or fewer houses, apartments, or mobile homes
Source: 1990 US Census

The coliform group of bacteria is recognized as a microbial indicator of drinking water quality because these bacteria are commonly found in the environment, are present in large numbers in feces, and are easily detected by simple laboratory methods. *E. coli*, a member of the coliform group, is found only in fecal material. The presence of coliform bacteria in a water system indicates vulnerability to contamination and ineffective disinfection whereas the presence of *E. coli* indicates fecal pollution. People drinking water with these bacteria are at increased risk of contracting a waterborne disease.

In addition to measuring bacteria, samples were collected for nitrate and atrazine analysis. The major sources of nitrate in groundwater include fertilizers, animal manure, seepage from septic systems, and atmospheric fallout from combustion of fossil fuel. Background levels of nitrate in ground water may reach 3 mg/L because of natural decomposition and soil bacteria. Higher nitrate levels are associated with anthropogenic activity (Mueller et al., 1995). The Environmental Protection Agency (EPA) established an MCL of 10 mg/L for nitrate-nitrogen in public water systems (EPA, 1994) because infants are particularly susceptible to nitrate and may develop methemoglobinemia (Coomley, 1945).

Triazines are organic herbicides introduced in the 1950s. These synthetic chemicals are among the most widely used and effective herbicides in the world. In the Midwest, atrazine is used seasonally to control grassy and broadleaf weeds in corn and wheat fields. The chemical is applied to the surface of the land and degrades quickly when exposed to light. However, the half-life of atrazine in soil or water is several months (EPA, 1984a). Atrazine is the most commonly found herbicide in ground and surface water because of its high use, persistence in the environment, and ability to dissolve in water. The chemical is mutagenic in bacteria and is considered a possible human carcinogen (IARC, 1991).

The purpose of the survey was to measure levels of coliform bacteria, *E. coli*, nitrate, and atrazine in water collected from households that are supplied water from a domestic well water system in nine midwestern states. This concern originated when many water samples from rural wells collected shortly after the 1993 midwest floods tested positive for coliform bacteria or *E. coli*. Public health officials from the affected states and from federal agencies met to discuss the contamination. They concluded that the available data was insufficient to characterize the nature and magnitude of the situation. They agreed to conduct a survey of the geographic distribution of chemical and bacteriological contamination of water from domestic well water systems in the affected states. The survey would collect information on the construction, maintenance, and condition of the well. To correlate health effects with contamination, participants in the survey would be asked whether they had a diarrheal episode in the 2 weeks before the water sample was collected from their house.

Methods

Any household in the nine upper midwestern states that used a domestic well to supply water for drinking, cooking, or bathing was eligible for the survey. The EPA defines a public water system as having at least 15 service connections or regularly serves an average of 25 people daily for 60 days out of the year (EPA, 1995). In this survey, a domestic well had fewer than 15 service connections and regularly served fewer than 25 people. Field personnel collected a water sample from the household closest to and within 3 miles of each intersection of a 10 mile grid overlaid on the 9 states. The grid was constructed by randomly choosing a starting point outside the 9-state region as the lower left corner (Gulf of Mexico). ArcInfo (Environmental Systems Research Inc., 1993) was the primary geographic information system (GIS) used to construct the sampling grid. This program also generated a list of the latitude and longitude of each grid intersection, a unique identification number for each intersection, and printed maps of each county showing the major rivers, roads, and railroads in the county, and the location and the unique identification number of each sampling unit (the area within a 3-mile radius of the intersect) in the county (Figure 1).

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Figure 1. A county map used to locate households to be sampled in the 1994 Midwest Well Water Survey. Households nearest to the intersection and within the circle and county sampled.

When a sampling unit included more than one county, field personnel did not enter the adjacent county to collect that sample. Most field personnel were familiar with the area in which they were assigned to collect samples. Real-estate plats, U.S. Geological Survey quadrangles, and municipal maps were also used to locate the households to be sampled. Field personnel were employed by the state agency that was conducting the survey.

A systematic geographical sampling approach was used because a list of domestic wells was not available and variables that affect water supply and quality (e.g. geology, soil type, topography, land use, etc.) are not randomly distributed. In addition, conducting a census of wells in each sampling unit would have been difficult and time-consuming.

Collection of water samples

Water samples were collected from May to November 1994. Field personnel located the household closest to the grid intersection and asked an adult resident for permission to collect a water sample. An eligible household received water from a domestic well, had at least one member who drank the water, and was within 3 miles of the intersection. In addition, the well must not have been chlorinated in the previous 4 days because chlorine that was used to disinfect the well may still be present. If the resident declined to participate or the well did not meet enlistment criteria, the field personnel proceeded to the next closest household. If no well was sampled in the designated sampling unit, field personnel proceeded to the next sampling unit. When no households with wells could be found in several sampling units within a county, the sampling unit within that county was extended to a 5-mile radius from the grid intersection.

When a household member granted permission, field personnel marked the approximate location of the sampled well on the survey map or recorded the latitude and longitude of the sampled well if geographical positioning system instruments were available. Water samples were collected from the faucet most commonly used to provide drinking water. When possible, aerators, strainers, hoses, water treatment devices, or other attachments were removed before the sample was collected. Taps were sanitized by wiping the inside and outside of the tap with a paper towel or cotton-tipped swab saturated with 100 mg/L sodium hypochlorite. The tap was opened fully for 3 to 5 minutes prior to sampling, and then the water flow was reduced during sample collection. The sample bottle cap was removed, and without rinsing, sufficient water was collected to fill four-fifths of the container. Water was collected in polyethylene bottles for bacteriologic analysis. Two milliliters of dilute sulfuric acid were added to the sample bottle for nitrate and atrazine analysis. The caps were immediately replaced without touching the interior of the cap or container. After collection, samples were placed on ice until they were delivered to the state laboratory. Microbiology testing begun within 30 hours of collection.

Duplicate samples were chosen in advance. In each state, the survey coordinator decided the rate at which duplicate samples were collected -- usually every eighth, ninth or tenth household -- and maintained this frequency throughout the state. Field surveyors collected the duplicate samples at the preselected rate. If no sample could be collected at the designated site, the sample was collected at the next available sample site.

Data Collection Form

In addition to collecting water samples, field personnel interviewed survey participants to obtain information on the construction, condition, and maintenance of the well; the potential sources of contamination; the number of people drinking water from the well; and the occurrence of diarrhea in the household (Appendix I). For most wells, a sanitary survey was performed to determine the condition of the well; the character of local geography; and the nature, distance, and location of potential pollution sources in the area.

Laboratory Analysis

Coliform Bacteria and *E. coli*. A 10-tube assay (Colilert, IDEXX Laboratories Inc., 1994) measured the concentration of coliform bacteria and E. coli in the water samples. In this procedure, an aliquot of the sample is placed in each of ten tubes containing nutrient broth and indicator chemicals. The broth turns yellow when coliform bacteria metabolize O-Nitrophenol-b-d-galactopyranoside and fluoresces under ultraviolet light when E. coli breaks down 4-methylumbellifery-b-d-glucuronide. The medium contains chemicals tha suppress the growth of noncoliform bacteria. The result, number of coliform bacteria or E. coli per 100 mL, is a statistical estimate of the mean density of bacteria in a water sample and is based on the number of samples testing positive. The assay had a quantitative range from 1.1 (95% confidence interval 0.0., 5.9) to 23 (95% confidence interval 8.1, 59.5) bacteria per 100 mL.

Nitrate. The colorimetric, automated, cadmium reduction method (APHA, 1992) measured nitrate concentrations as milligrams nitrate-nitrogen per liter (mg/L NO3-N). The preserved water sample was filtered and passed through a column containing granulated copper-cadmium. This step converts nitrate (NO3) tonitrite (NO2), which forms an azo dye when sulfanilamide couples with N-(1-naphthyl)-ethylenediamine dihydrochloride. The azo dye is measured colorimetrically and is proportional to the amount of nitrate in the sample. This assay had a limit of detection of 0.01 mg/L.

Atrazine. An enzyme-linked immunosorbent assay measured atrazine in the water samples (Ohmicron, 1995). This method used atrazine-selective antibodies linked to a peroxidase enzyme detector system. In the presence of atrazine, a colored product is formed that is inversely proportional to the concentration of triazines in solution. As with most immunoassays, structurally related chemicals may cross-react with the antibody. These include other triazines such as cyanazine, simazine, and terbutryn and the atrazine metabolites 6-hydroxy atrazine and, desisopropyl atrazine. This assay had a limit of detection of 0.05 ppb.

Quality Assurance

In an effort to produce data that is precise and comparable, standard protocols for sample collection and analysis were established by the laboratories conducting the water analysis. One quality control procedure involved collecting duplicate samples for every eighth to tenth well. The difference between the original and the duplicate samples for coliform bacteria, E. coli, or nitrate was not statistically significant ($p = 0.14$, student=s t-test). Other quality control measures used by the laboratories included standardized sample collection and transport procedures; standard solutions, reagents, and preservatives; and use of analytical reagents with the same lot number for the Colilert and the atrazine assays. Laboratories also performed routine internal quality control procedures.

Data Analysis

Data entry. State survey coordinators mailed completed data collection forms, county maps, lists of well identification numbers, and the latitude and longitude of each well, when available, to CDC. Forms were examined for completeness and logged into a program that monitored the progress of each form in the data-entry process. The latitude and longitude of each well were entered into an ArcInfo data base. The data were double-entered. Each state's well survey manager reviewed a data base of the information of the wells sampled in their state.

Contamination levels. The EPA established limits on the level of contaminants in drinking water to ensure that public water systems deliver water that is safe for human consumption. These limits are known as the maximum contaminant levels (MCLs) -- the highest allowable amount of a contaminant that a public water supply can deliver to a consumer. A violation occurs when an MCL is exceeded. The MCL is 10 mg/L for nitrate and 3 ppb for atrazine (EPA, 1994). For bacteriological monitoring, the EPA established the total coliform rule, which states that any water sample that tests positive for coliform bacteria must be analyzed for fecal coliform or E. coli. A positive test result is when coliform bacteria or E. coli concentration is at least one per 100 mL of sample. A repeat test is conducted for each positive sample and samples are collected within 24 hours of a positive test result. A violation occurs when coliform bacteria or E. coli are present in both the initial and repeat sample. While these standards pertain to public water systems, they served as guidelines for assessing the quality of water collected in this survey. Thus a water sample collected from a household served by a domestic well was considered to be contaminated if coliform bacteria or E. coli concentrations were detected, if nitrate concentrations exceeded 10 mg/L, or if atrazine levels were above 3 ppb.

Statistical analysis. Odds ratios were calculated to order to determine the strength of the association between a well feature (e.g., depth, presence of cracks in casing, pesticide use near the wellhead) and the presence of contaminants in the water samples (coliform bacteria, E. coli, nitrate, or atrazine). Results for atrazine are not reported because only 0.2% of the samples had levels that exceeded the MCL. An odds ratio less than one indicates that the well feature was associated with a lower contamination rate than the wells without that feature, an odds ratio greater than one implies that the well feature was associated with a higher contamination rate, and an odds ratio of one shows that the well feature had no association with the contamination rate. To examine the association between well construction and contamination, we chose drilled wells as the reference because they constituted the largest group and had samples with one of the lowest rates of contamination.

Epi Info version 6.0 was used for the descriptive analysis and calculation of odds ratios (Dean et al., 1994). SAS version 6.10 (SAS Institute Inc., 1991) was used to run the logistic regression to examine for associations between the analytes and well depth, age, and casing diameter. ArcInfo (Environmental Systems Research Inc., 1993) and MapInfo (MapInfo Inc., 1994) were used in the descriptive analysis of the spatial distribution of the analytes. ArcInfo was also used to examine for associations between the analytes and well location, political boundaries, bodies of water, soil type, household income, and the presence of multiple analytes in water samples.

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Results

Participation

Water samples were collected from houses in 5,536 (87.9%) of the 6,298 grid points in the sampling frame (Figure 2). Water samples were not collected from 445 (7.1%) households because these houses did not have a domestic well or received water from a public water supply, or because the sampling unit was in a lake, river, swamp or mountain. In 186 (3.0%) of the households, no resident was present to give permission to collect a water sample. Residents in 131 (2.0%) households declined to participate in the survey. Of the 5,536 water samples collected, 16 (0.3%) were excluded from the analysis because they were from a cistern, spring, or community well. Thus the analysis was based upon 5,520 samples.

Figure 2. Location of sampling areas in the 1994 Midwest Well Water Survey

Analytes

Bacteria. Coliform bacteria were present in 41.3% of the water samples. The proportion of samples testing positive for coliform bacteria ranged from 22.8% in Wisconsin to 58.6% in Iowa (**Table 2**). *E. coli* was detected in 11.1% of all the samples and in 27.0% of the samples with coliform bacteria. *E. coli* was recovered only from samples testing positive for coliform bacteria because *E. coli* is a member of the coliform bacteria group and will, by itself, produce a positive total coliform result. Nebraska (2.5%) and Wisconsin (2.6%) had the lowest proportion of samples with *E. coli*, and Iowa (20.5%) and Missouri (22.6%) had the highest. The two largest groups of samples had coliform bacteria or *E. coli* densities less than 1.1/100 mL or greater than 23/100 mL (Figure 3).These values represent the lower and upper quantitative limit of the assay.

Table 2.
The percentage of water samples that tested positive for coliform bacteria and for *E. coli* and the percentage with nitrate or atrazine concentrations above the maximum contamination level for public water supplies, 1994 Midwest Well Water Survey

State	Analytes				
	Coliform Bacteria	*E. coli*	Nitrate >10 mg/L	Atrazine > 3 ppb	N
Illinois	45.9	15.4	15.3	0.0	540

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Iowa	58.6	20.5	20.6	0.4	526
Kansas	48.7	16.3	24.3	0.6	716
Minnesota	27.3	04.5	05.8	0.1	718
Missouri	57.4	22.6	09.7	0.0	632
Nebraska	37.3	02.5	14.7	0.2	598
North Dakota	35.5	08.2	13.5	not tested	673
South Dakota	40.1	08.4	10.4	0.0	583
Wisconsin	22.8	02.6	06.6	0.2	534
Total	**41.3**	**11.1**	**13.4**	**0.2**	**5,520**

N = number of wells tested for coliform bacteria. A similar number of wells in each state were tested for the other analytes. Coliform bacteria or *E. coli* greater than or equal to 1.1 cfu/100 mL.

Figure 3. Coliform bacteria and E. coli concentration of well water samples collected in the 1994 Midwest Well Water Survey

Nitrate. Of the 5,500 samples submitted for nitrate analysis, 65.4% were above the limit of detection, 31.8% were above 3 mg/L, and 13.4% were above 10 mg/L. The mean nitrate level was 8.4 mg/L (SD = 16.9 mg/L) and ranged from nondetectible (less than 0.01 mg/L) to 266 mg/L. Minnesota (5.8%) and Wisconsin (6.6%) had the lowest proportion of samples with nitrate levels above 10 mg/L, and Iowa (20.6%) and Kansas (24.6%) had the highest. Twenty samples were not tested for nitrate because of insufficient volume of sample, loss of sample in transit, or a laboratory error.

Atrazine. Eight of the nine states collected water samples for atrazine testing. This herbicide was not measured in the samples collected in North Dakota because of low use in the state. Of the 4,828 samples tested for atrazine, 13.6% were above the limit of detection and 9 samples (0.2 %) were above 3.0 ppb. The mean atrazine concentration was 0.40 ppb (SD = 1.3 ppb) and ranged from nondetectible (less than 0.05 ppb) to 29.0 ppb.

Samples with multiple contaminants. There were 208 samples (3.8%) that contained coliform bacteria, *E. coli*, and elevated nitrate levels. Samples from bored wells had the highest rate (20.0%), followed by those from dug (16.9%), drilled (1.4%) and driven (0.3%) wells. Of the samples with elevated nitrate levels, coliform bacteria were present in 67.8% and *E. coli* in 28.1% of the samples (Table 3). *E. coli* was present in 27.0% of the samples with coliform bacteria.

Table 3. Coliform Bacteria, *E. coli* and nitrate in samples from the 1994 Midwest Well Water Survey

	***E. coli* - Number of samples**		**Nitrate- Number of samples**	
	absent	**present***	**< or = 10 mg/L**	**> 10 mg/L**

Coliform Bacteria absent	3238	0	2987	238
present	1666	616	1774	501
E. coli absent	--	--	4354	531
present	--	--	407	208

*>= 1.1. cfu/100mL

Well construction and contaminated water samples

Drilled wells were the most common construction type throughout the nine states, with dug wells a distant second (**Table 4**). Dug and bored wells were primarily in Illinois and Iowa, wells with a buried slab were mainly in Illinois, and driven wells were most commonly found in Wisconsin.

Table 4. Construction methods used to build wells in 1994 Midwest Well Water Survey

State	Construction Method (percent)							
	Drilled	Dug	Driven	Bored	Buried slab	Other	Unknown	Total
IL	54.4	24.4	6.5	6.5	6.5	0.7	0.9	540
IO	60.3	10.6	2.5	20.7	1.3	4.0	0.6	526
KS	79.9	17.7	0.8	0.1	0.1	1.0	0.3	716
MN	80.8	6.1	8.5	2.4	0.0	0.6	1.7	718
MO	72.6	12.7	7.3	5.9	0.5	0.2	0.9	632
NE	91.1	1.8	1.7	0.0	0.3	0.2	4.8	598
ND	83.5	11.4	3.7	0.4	0.1	0.3	0.4	673
SD	82.3	7.7	5.7	1.4	0.0	2.1	0.9	583
WI	83.0	2.1	12.7	0.0	0.0	0.4	1.9	534
Total	77.0	10.6	5.4	3.8	0.9	1.0	1.4	5520

Wells in the survey had features similar to wells built by the same construction method. For example, most bored, buried slab, dug, and driven wells were shallow; dug wells were typically 2 to 4 feet wide and lined with concrete tile; drilled and driven wells were deeper and had small diameter steel or plastic casings (**Table 5**).

Table 5. Construction features of wells in the 1994 Midwest Well Water Survey

Construction type	Age (years)	Depth (feet)	Casing Diameter (inches)	Casing Type (percent)
Bored	15-40	30-53	20-36	concrete tile (91.9)
Buried slab	4-18	35-60	24-36	concrete tile (58.1)
Drilled	10-30	75-220	4-6	steel (63.5)
Dug	35-75	20-40	24-48	brick (56.9)
Driven	11-40	20-56	1-2	steel (84.6)

Ranges are the values for the 25% and 75% quartiles

When compared with samples from drilled wells, water samples from bored or dug wells were 10 to 15 times more likely to contain coliform bacteria or *E. coli* and 4 to 6 times more likely to have nitrate concentrations above 10 mg/L (**Table 6**). Water samples from wells with buried slabs were four times more likely to have coliform bacteria or *E. coli*. Water samples from driven wells, however, were less likely to have these bacteria than were samples from drilled wells. The odds ratios for atrazine were not calculated because only 9 samples exceeded 3 ppb, the MCL for public water systems.

Table 6. Well construction type and the risk of having coliform bacteria, *E. Coli* or nitrate in water samples collected in the 1994 Midwwest Well Water Survey

Well Type	**Coliform Bacteria**		***E. coli***		**Nitrate**	
	Odds ratio	*(95% Confidence Interval)*	*Odds ratio*	*(95% CI)*	*Odds ratio*	*(95% CI)*
Drilled	1.00	Referent	1.00	Referent	1.00	Referent
Bored	11.77	(7.79-17.88)	12.60	(9.18-17.30)	5.93	(4.37-8.04)
Buried slab	4.71	(2.44-9.22)	4.01	(1.79-8.71)	1.17	(0.76-3.96)
Dug	10.33	(8.17-13.14)	15.47	(12.46-19.21)	4.02	(3.31-5.02)
Driven	0.45	(0.33-0.61)	0.56	(0.26-1.13)	1.26	(0.86-1.83)

Coliform bacteria or *E. coli* greater than or equal to 1.1 cfu/100 mL
Nitrate concentration greater than 10 mg/L
CI = confidence interval

Water from wells with a brick or concrete casing (typical of dug, bored, and buried slab wells) was more likely to contain coliform bacteria, *E. coli*, or elevated nitrate levels than did water from wells with a steel casing (**Table 7**). Water from wells with a plastic casing was less likely to contain coliform bacteria or *E. coli* than water from wells with a steel casing. Results from samples collected from wells with steel casings were chosen as the referent because they constituted the largest category.

Table 7. Casing material and the risk of having coliform bacteria, *E. coli* or nitrate in water samples collected from wells in the 1994 Midwestern Well Survey

	Coliform Bacteria		***E. coli***		**Nitrate**	
Casing Material	*Odds Ratio*	*(95% Confidence Interval)*	*Odds Ratio*	*(95% CI)*	*Odds Ratio*	*(95% CI)*
Steel	1.00	Referent	1.00	Referent	1.00	Referent
Brick	18.85	(12.82-27.85)	21.68	(16.53-28.44)	5.56	(4.24-7.29)
Concrete	7.30	(5.88-9.06)	6.44	(5.08-8.17)	5.56	(4.45-6.94)
Plastic	0.80	(0.69-0.92)	0.41	(0.28-0.60)	1.55	(1.25-1.92)

Coliform bacteria or *E. coli* greater than 1.1 cfu/100 mL
Nitrate concentration greater than 10 mg/L
CI = confidence interval

Table 8 contains the adjusted odds ratios for well diameter, age, and depth that are corrected for the effect of the two other well features. Coliform bacteria or *E. coli* were 4 to 5 times more likely to be present in water samples from wells with a casing diameter greater than 6 inches. Samples from wells older than 25 years or shallower than 100 feet had a modestly increased chance of containing coliform bacteria, *E. coli* or elevated nitrate than did samples from newer or deeper wells.

Table 8. Adjusted odds ratios of well characteristics associated with coliform bacteria, *E. coli* or elevated nitrate in water samples collected in the 1994 Midwest Well Water Survey

	Coliform Bacteria		***E. coli***		**Nitrate**	
Well Feature	*Odds ratio*	*(95% Confidence Interval)*	*Odds Ratio*	*(95% CI)*	*Odds ratio*	*(95% CI)*
Diameter (> 6 inches)	4.3	(3.7-5.1)	5.3	(4.2-6.7)	2.2	(1.8-2.8)
Age (> 25 years)	2.1	(1.8-2.4)	2.5	(2.0-3.1)	1.3	(1.1-1.7)
Depth (< 100 feet)	1.6	(1.4-1.9)	2.2	(1.7-2.9)	2.2	(1.8-2.9)

Coliform bacteria or E. coli greater than 1.1 cfu/100 mL
Nitrate concentration greater than 10 mg/L
OR = odds ratio, adjusted for the two other features; CI = confidence interval

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Pitless adapters were installed in 44.2% of the wells and backflow devices were in 20.7% of the wells, and they significantly reduced the risk for contamination (**Table 9**). Sealed wells also decreased the risk for contamination, whereas a cracked casing or open lid significantly increased this risk. Dug wells (46.0%) had the most openings or cracks, followed by bored wells (40.0%), drilled wells (15.4%) and driven wells (11.0%).

Table 9. Selected well characteristics and coliform bacteria, *E. coli*, or nitrate in water samples collected in the 1994 Midwestern Well Water Survey

	Coliform Bacteria		*E. coli*		Nitrate	
Well Feature or Condition Present	*OR*	*(95% CI)*	*OR*	*(95% CI)*	*OR*	*(95% CI)*
Pitless adapter	0.36	(0.31-0.40)	0.20	(0.16-0.25)	0.45	(0.37-0.54)
Backflow devices	0.64	(0.56-0.74)	0.63	(0.50-0.81)	0.79	(0.64-0.98)
Cap	0.40	(0.33-0.50)	0.38	(0.29-0.49)	0.05	(0.04-0.05)
Standard cap	0.39	(0.34-0.44)	0.12	(0.10-0.14)	0.41	(0.34-0.49)
Sanitary cap	0.37	(0.31-0.45)	0.32	(0.27-0.40)	0.51	(0.43-0.61)
Sealed	0.34	(0.30-0.38)	0.27	(0.22-0.33)	0.41	(0.34-0.49)
Open lid	2.96	(2.56-3.42)	3.63	(3.00-4.40)	2.17	(1.80-2.61)
Cracked casing	4.46	(3.49-5.72)	7.21	(5.60-9.28)	2.21	(1.67-2.91)

Coliform bacteria or *E. coli* greater than 1.1 cfu/100 mL
Nitrate concentration greater than 10 mg/L
OR = odds ratio, the referent group for each feature were wells that did not have that specific feature;
CI = confidence interval

Sanitary survey

The sanitary survey revealed that potential contamination sources were commonly found within 100 feet of the well head (**Table 10**). Septic tanks and lateral fields, structures that contain human fecal material, were the most common pollution sources. Less than 1% of the wells had a sewage lagoon, silage storage, agricultural drain, or sink hole within 100 feet. One-fourth of the wells had a contamination source within 100 feet and were down gradient from that pollution source.

Table 10. Domestic wells with potential contamination sources or conditions within 100 feet of the well head, 1994 Midwest Well Water Survey

Source Well	Source within 100 feet of the Number of Wells	Percent
Septic Well	1669	31.9
Lateral Field	932	18.1
Outhouse	153	2.9
Down gradient from pollutant	1378	25.7

Surface Water	534	12.7
Abandoned Well	617	11.9
Flood plain	348	7.0
Cistern	489	9.4

The frequency that a contaminant was found in water samples from wells with a pollutant source within 100 feet was compared with the frequency of that contaminant in samples from wells with the same type of pollutant source more than 100 feet from the well (**Table 11**). Septic tanks within 100 feet of a well were associated with coliform bacteria and *E. coli* in water samples, whereas lateral fields and outhouses showed no association. A well down gradient from a pollution source was associated with presence of coliform bacteria, *E. coli*, and elevated nitrate levels. A cistern within 100 feet of a well was associated with coliform bacteria in water samples.

Table 11. Possible contamination sources or conditions within 100 feet of a domestic well and presence of coliform bacteria, *E. coli*, or elevated nitrate levels in water samples collected in the 1994 Midwest Well Water Survey

	Coliform Bacteria		***E. coli***		**Nitrate**	
Contamination source	**OR**	**(95% CI)**	**OR**	**(95% CI)**	**OR**	**(95% CI)**
Septic Tank	1.22	(1.07-1.37)	1.32	(1.09 - 1.61)	1.10	(0.92- 1.320)
Lateral Field	0.82	(0.71-0.94)	0.77	(0.61-0.98)	0.77	(0.62-0.96)
Outhouse	0.87	(0.61-1.22)	1.13	(0.67-1.88)	0.79	(0.46-1.35)
Down gradient	1.23	(1.09-1.40)	1.38	(1.07-1.80)	1.59	(1.34-1.89)
Surface water	1.11	(0.93-1.31)	1.24	(0.96-1.60)	1.10	(0.86-1.40)
Flood plain	0.90	(0.76-1.19)	0.92	(0.63-1.32)	1.02	(0.73-1.41)
Abandoned well	0.75	(0.63-0.90)	0.63	(0.46-0.86)	0.85	(0.65-1.10)
Cistern	1.64	(1.36-1.99)	1.21	(0.90-1.61)	1.28	(0.98-1.66)

Coliform bacteria or E. coli greater than 1.1 cfu/100 mL
Nitrate concentration greater than 10 mg/L
OR = odds ratio, adjusted for the two other features; CI = confidence interval

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Pesticides, manure, and fertilizers are often applied near wells and most of the applications occurred within the past 5 years (**Table 12**). When applications within the previous 5 years and within 100 feet of the wellhead were examined, the presence of coliform bacteria, E. coli, or elevated nitrate levels in water samples was associated with the use of these agricultural products (**Table 13**). This association was examined by comparing the contamination rate of samples from wells with applications within 5 years and 100 feet of the wellhead to the rate of samples from wells that had no applications or applications more than 5 years before the survey and beyond 100 feet of the wellhead. Pesticide use was associated with coliform bacteria, E. coli, and elevated nitrate levels in well water samples. The use of manure doubled the likelihood of an elevated nitrate level. The use of fertilizers increased the chance of detecting coliform bacteria and doubled the likelihood of an increased nitrate level.

Table 12. Application of agricultural chemicals near wells, 994 Midwest Well Water Survey

	Agricultural Product Applied		
Usage	**Pesticide (N = 5353)**	**Manure (N=5386)**	**Fertilizer (N= 5386)**
Ever used	41.8	29.7	52.0
In past 5 years	38.3	24.2	51.6
Within 100 ft	15.8	09.9	17.5
In past 5 years and within 100 ft	14.3	07.8	11.4

Table 13. Application of agricultural chemicals in the prior 5 years and with 100 feet of the well and the presence of coliform bacteria, *E. coli*, or elevated nitrate levels in water samples collected in the 1994 Midwest Well Water Survey

	Pesticide		**Agricultural Product Manure**		**Fertilizer**	
Analyte	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Coliform Bacteria	1.30	(1.11-1.61)	1.08	(0.88-1.61)	1.34	(1.11- 1.61)
E. coli	1.30	(1.03-1.65)	1.32	(0.98-1.63)	1.26	(0.96 -1.65)
Nitrate	1.67	(1.35-2.07)	1.95	(1.50-2.53)	1.90	(1.50 -2.41)

OR = odds ratio. CI = confidence interval. The wells with no application or applications more than 5 years ago and beyond 100 feet from the well head served as the referent group.

Diarrhea and contaminated water samples

The 5,520 wells in the survey provided water for 17,385 people. Of the 15,978 people who drank well water, 458 (2.9%) reported three or more watery stools in a 24-hour period within the 2 weeks before a sample was collected from their well. People over 17 years of age (70.8%) were the largest group who drank well water (**Table 14**).

Table 14. Ingestion of well water and diarrheal rate among residents of households served by a domestic well

	Under 6	Ages 7-17	Over 17	Total
Number who drank well water	11,315	3,547	1,116	**15,978**
Number who reported a diarrheal episode	306	100	52	**458**
Diarrheal rate (episodes/person/year)	0.70	0.73	1.21	**0.75**

The incidence of people reporting a diarrheal episode was not significantly associated with the presence of coliform bacteria or *E. coli* in water samples (OR = 1.15, 95% CI, 0.98-1.34 for coliform bacteria; OR = 1.13, 95% CI, 0.88-1.45 for *E. coli*). The incidence of households with at least one family member reporting a diarrheal episode was also not significantly associated with the presence of coliform bacteria or *E. coli* in water samples (OR = 1.16, 95% CI, 0.87-1.54 for coliform bacteria; OR = 0.88 95% CI, 0.56-1.38 for *E. coli*). All well types had similar rates of illness. There were 175 children younger than 6 years who lived in the 110 households that had well water with nitrate levels over 10 mg/L.

Coliform bacteria were present in water drawn from domestic wells throughout the nine-state region. Southern Illinois, Missouri, Iowa, and Kansas had a higher proportion of wells with these bacteria (Figure 4). Regions with a higher percentage of water samples containing E. coli were more limited and included southern Illinois, the Missouri-Iowa border, and eastern Kansas (Figure 5). Regions with a higher percentage of water samples containing elevated nitrate levels were southern Illinois, Iowa, northern Missouri, and Kansas (Figure 6). Atrazine was commonly detected in Illinois, Wisconsin, and Kansas (Figure 7).

Figure 4. Coliform bacteria in water samples collected from the 1994 Midwest Well Water Survey

Figure 5. E. coli in water samples collected from the 1994 Midwest Well Water Survey

Figure 6. Nitrate levels in water samples collected from the 1994 Midwest Well Water Survey

Figure 7. Atrazine levels in water samples collected from the 1994 Midwest Well Water Survey

Dug and bored wells are in a band that stretched from southern Illinois to the Iowa-Missouri border and then splits into eastern Kansas and north into northwestern Iowa (Figure 8). This distribution is similar to the spatial patter of water samples with E. coli. Spatial analysis did not reveal a significant relationship between well contamination and soil type, snowfall from the preceding winter, household income, or counties declared eligible for federal disaster assistance.

Figure 8. Distribution of wells construction of wells in the 1994 Midwest Well Water Survey

A Survey of the Quality of Water Drawn from Domestic Wells in Nine Midwest States

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Discussion

In the 1994 Midwest Well Water Survey, coliform bacteria, *E. coli*, nitrate, and atrazine were present in many water samples collected from households with a domestic well. Most of the samples with these pollutants were from old and shallow-dug or bored wells with a large-diameter brick or concrete tile casing. An opening in the well; a septic tank within 100 feet; a well down gradient from a pollutant source; and recent use of fertilizers, pesticides, or manure near the well each had a modest detrimental effect on water quality. A pitless adapter or a backflow device reduced the risk for contamination.

Several other studies measured coliform bacteria and nitrate in water from domestic wells. In a nation-wide survey of 2,654 rural wells, coliform bacteria were present in 78% and fecal coliforms were present in 12% of the samples (EPA, 1984b). Regional surveys in Iowa (Seigley et al., 1993) and Nebraska (Exner and Spalding, 1985) reported the presence of coliform bacteria in 78% and 47%, respectively, of the dug wells and 80% of bored wells sampled in Iowa. A nation-wide survey reported that 9% of 3,351 households with water wells and 1% of public wells in agricultural areas had nitrate levels above the EPA MCL of 10 mg/L (Mueller et al., 1995). Nitrate concentrations in 599 domestic wells in the midcontinental United States exceeded 3 mg/L in 29% of the samples and were over 10 mg/L in 6% of the samples (Mueller et al., 1992). In 686 rural wells, nitrate levels were greater than 10 mg/L in 18% of the samples collected in Iowa (Kross and Selim, 1992) and 22% of the 201 wells tested in Missouri (Sievers and Fulhage, 1992). These results were similar to those from the 1994 Midwest Well Water Survey - 41.3% for coliform bacteria, 11.1% for *E. coli*, and 13.4% for nitrate levels above 10 mg/L.

A review of studies that measured atrazine in public and private wells reported a range of 0.7 to 18.0% for the detection of this herbicide in the midcontinental states (Burkart and Kolpin, 1993). The wide range of detection was attributed to differences in laboratory reporting limits, well selection criteria, geography, and time of collection. Atrazine was detected in 0.7% in rural domestic wells in a national sampling of over 1,300 wells (EPA, 1992a). In 26,909 samples from wells that were tested for pesticides by state laboratories because of a request by the well owner or enforcement action by the state, atrazine was detected in 1,512 (5.6%) samples and exceeded the MCL in 172 (0.6%) samples (EPA, 1993). The 1994 Midwest Well Water Survey reported similar results for detection (13.6%) and the amount of samples above 3 ppb (0.2%).

The 1994 Midwest Well Water Survey and other studies reported the presence of coliform bacteria or *E. coli* in water from domestic wells. Because these bacteria serve as indicators of increased risk for diarrheal diseases, higher diarrheal rates would be expected for the people drinking water with these bacteria. However, the rate of diarrheal episodes reported by the people in the survey (0.75 per person per year) was similar to the endemic rate of gastrointestinal illness reported in other studies (Hodges et al., 1956; Monto and Koopman, 1980; Payment et al., 1991). In addition, in 1993 and 1994, only seven reports of waterborne outbreaks due individual wells were reported to the CDC (CDC, 1996). Not everyone who drinks water with coliform bacteria or *E. coli* will develop diarrhea. Coliform bacteria are sensitive indicators for pollution and are a poor predictor for diarrhea. Coliform bacteria are ubiquitous in the environment. Both coliforms and *E. coli* generally do not cause gastroenteritis in healthy people. When these bacteria are detected in a water sample, microorganisms that cause gastroenteritis may not be present. Even if pathogenic bacteria are present, a person may not ingest an infective dose or may be immune to the organisms. Finally, the coliform standard (less than one coliform per 100 mL of water) includes a margin of safety.

Domestic wells in this survey had a higher "noncompliance rate" for coliform bacteria than community water systems. In 1994, 1% of the community water systems serving 25 to 500 people violated treatment technique requirements and 8% violated MCL standards (EPA, 1995). The treatment technique requirements usually relate to the presence of coliform bacteria or *E. coli*, and the MCL violations usually relate to chemicals such as nitrate and atrazine that exceed their regulatory level. In the Midwest Well Water Survey, 41% of the samples contained coliform bacteria, 11% contained *E. coli*, and 13% contained nitrate levels above 10 mg/L. Survey participants were informed of the test results of their well water.

The higher "noncompliance rate" of water samples from domestic wells may be due in part to a more stringent definition for a contaminated sample than for public water systems. In this survey, a contaminated water sample was defined as one that contained more than 1 coliform bacteria per 100 mL. When coliform bacteria is detected in public water systems, repeat samples are collected to verify the presence of coliform bacteria or *E. coli*. If either bacteria is present in a repeat sample, the public water system is in violation of EPA guidelines. Repeat samples were not routinely collected in the survey but all water samples were tested for *E. coli*, and as noted above, 11% tested positive. Since coliform bacteria are common in the environment, the proportion of samples containing *E. coli* may be a better representation of the degree of contamination measured by a single-sample survey. Bacterial contamination usually results from the lack of proper disinfection of a well following repair or construction, failure to seal the annular space between the drill hole and the outside of the casing, failure to provide a tight sanitary seal, or wastewater pollution of the well through polluted strata or a fissured or channeled formation.

Site characteristics and well features and construction affect water quality. A survey of 231 domestic wells in Iowa showed that well depth, location, and construction type, and nearby pollution sources affect the quality of the water drawn from these wells (Seigley et al., 1993). A state-wide survey in Iowa demonstrated that well depth and construction type had a strong association with contamination (Hallberg et al., 1992). Deficiencies in well construction were common among 268 household and stock wells in Nebraska (Exner and Spalding, 1985). In this survey, the wells least likely to contain contaminants met all the criteria for construction. In the 1994 Midwest Well Water Survey, samples from wells that were older or shallower or had a large-diameter brick or concrete casing usually contained higher levels of coliform bacteria, *E. coli*, and nitrate. These are features of dug and bored wells, which also had a higher frequency of cracks in the sanitary seals, grouting, or casing than drilled wells. These conditions allow material to enter the well and seepage of surface water.

Although the 1993 floods were the reason this survey was conducted, the lack of sufficient preflood water quality data on the sampled wells prohibited assessment of the effect of the flood on ground water quality. In addition, because the survey was conducted 1 year after flood waters receded, data from this survey may not reflect conditions directly related to the flood. A study by the USGS showed that groundwater quality was affected by the 1993 midwest flood (Koplin et al., 1996). In that survey, water samples were taken in July and August 1993, and levels of various pollutants were compared with preflood values. The concentration of herbicides showed a 20% increase in water samples collected in areas severely affected by floods. Water in shallow wells more quickly reflected changes in water quality because of to changes in recharge from the 1993 flooding.

Limitations of the Survey

1. The survey was observational and did not address causation. Statistical associations between pollution indicators and well features or conditions does not prove that one factor causes the other.

2. The survey used a single sample to provide information on coliform bacteria, *E. coli*, nitrate, and atrazine. However, a single sample does not define a contaminated water system or aquifer. Repeat samples should be taken to verify the presence of these contaminants.

3. The absence of coliform bacteria or *E. coli* in a single water sample does not assure that a water supply is free of coliform bacteria. A history of water samples with no coliform bacteria or E. coli, an absence of nearby pollution sources, and a properly constructed and maintained water well system are better indicators.

4. Samples were collected at the point of use (usually the kitchen faucet) and reflect the quality of the water that passed through existing holding tanks, treatment systems, and distribution pipes, rather than just the quality of the water drawn from the well.

5. The survey cannot answer whether the flooding was directly responsible for contamination of the wells. Limited data was available on the water quality of the wells in the survey before the 1993 floods. The survey was conducted 1 year after the floods, too late to measure the direct effect of the flood on bacterial and chemical water quality.

6. The wells in the survey may not be representative of all the wells in each state. Samples were collected from households at the intersections of a 10 mile grid although the 1990 US Census show that private wells are not evenly distributed spatially. Consequently, areas with a high density of wells will be under sampled and areas with a low density of wells will be over sampled. In addition, each well did not have an equal chance of being sampled.

7. Because of the small number of samples collected in each county and the resultant lack of statistical power, comparisons can not be made between of within counties.

Conclusions

1. Forty-one percent of the water samples collected from households with a domestic well contained coliform bacteria in excess of one per 100 mL. Eleven percent of the samples

contained *E. coli* in excess of one per 100 mL. Nitrate concentrations above 10 mg/L were present in 13.4% of the samples and atrazine concentrations above 3 ppb were present in 0.2 % of the samples.

2. The most notable factors associated with the presence of coliform bacteria, *E. coli*, or nitrate levels above 10 mg/L were related to well construction and the condition of the well. Samples with these pollutants were more likely to come from households with old, shallow, large-diameter dug or bored wells with tile or brick casings than the small-diameter drilled or driven wells with a steel or plastic casing. A cracked casing or opening in the well greatly increased the risk for contamination. A pitless adapter or backflow device reduced the likelihood of contamination.

3. Samples from wells located near pollution sources were slightly more likely to contain pollutants. The application of agricultural chemicals, the presence of septic tanks or cisterns within 100 feet of the well, and a well that was down gradient from a pollution source had a modest detrimental effect on the quality of water.

4. People who drank water with coliform bacteria or *E. coli* had a similar rate of self-reported diarrhea as people who drank water that did not contain these bacteria. There are several possible explanations for this result. Coliform bacteria and *E. coli* are sensitive measures of pollution but are weak predictors of diarrheal episodes. In healthy people, these bacteria generally do not cause gastroenteritis. When they are detected in a water sample, microorganisms that cause gastroenteritis may or may not be present. Even when pathogenic bacteria are present, a person may not ingest an infective dose or may be immune to the organisms. In addition, the criteria of more than one coliform per 100 mL of water for unacceptable water includes a wide margin of safety.

Recommendations

1. Inform people that rely on dug or bored wells for their drinking water about the potential hazards of ingesting water from these wells.

2. Routinely test water from domestic wells for coliform bacteria, *E. coli*, and nitrate. Monitoring of other chemicals should be based upon an assessment of potential contamination. Most states require testing for coliform bacteria before a new well is used and before transfer of ownership of land that contains a well. The EPA recommends users of household wells to test for bacteria once a year, quarterly if any changes in the water=s taste, odor, or color occurs, and after heavy rainfall or floods (EPA, 1990). The EPA suggests annual testing for nitrate, when coliform bacteria are found in the water, and after repairs to the well, pump, storage tank and piping.

3. Properly disinfected a well as soon as possible when a repeat sample confirms the presence of coliform bacteria or *E. coli*. Water samples should be negative for coliform bacteria before providing water for consumption. As a safeguard, well water used for drinking or food preparation should be boiled or an alternative safe water supply used until satisfactory results are obtained. Wells that fail to respond to proper disinfection procedures should be evaluated and corrected for deficiencies in location or construction, and, when necessary, replaced with a well that meets the state=s well code. Connection to a community water system

should be considered if a suitable well cannot be drilled.

4. Do not give water with nitrate-nitrogen levels exceeding 10 mg/L to infants under 6 months of age, either directly or in formula. A sanitary survey should be performed to identify potential sources of nitrate that could contaminate the groundwater and to evaluate the condition of the well. If removing the nitrate sources or repairing the well fails to lower the nitrate level of the water below 10 mg/L, the well user should consider using other safe sources of water, treating the water, drilling a new well, or connecting to a community water system.

5. Evaluate domestic wells providing water that exceeds the health limits for synthetic chemicals. Connection to a rural or community water system should be considered if reconstruction, replacement, or treatment is not feasible.

6. Develop, maintain, and evaluate programs that monitor domestic wells. These may include periodic tests for water quality and sanitary surveys, technical assistance and educational programs for well drillers, owners, and consumers of well water, and efforts to identify and seal abandoned wells. In 1990, 46 states licensed or registered water well drillers and 42 states established construction standards for new water wells. However, once a well is constructed and its water is declared potable, domestic well water systems are subject to few regulations.

7. Encourage domestic well owners to routinely maintain their wells. Maintenance involves the early detection and correction of problems that could impair water quality and well performance. Well owners can schedule sanitary surveys to assess existing and potential health hazards and to evaluate the present and future importance of these hazards. Records should be kept of well construction, repairs, pumping tests, and tests of water quality.

8. Protect the wellhead and aquifers from contamination. Mitigation of contaminated aquifers is expensive, inefficient, and unreliable. Failure to provide adequate protection may expose the consumers of the water to agents of waterborne diseases.

9. Enhance waterborne disease surveillance. State and county laboratories can share information on the water samples submitted by well owners with state and local health departments. This information can be used to characterize the domestic well water systems in the United States.

A Survey of the Quality of Water Drawn from Domestic Wells in Nine Midwest States

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Centers for Disease Control and Prevention (CDC) ... National Center for Environmental Health (NCEH)

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A Survey of the Quality of Water Drawn from Domestic Wells in Nine Midwest States:

Data Collection Form
Appendix 1 - Page 1

see also: Appendix 1 - Page 3

Appendix I - Data Collection Form Used in the Survey of

Data Collection Form - Survey of Well Contamination
Midwestern States Affected by 1993 Flooding

/ Do NOT survey well if chlorinated within last 4 days! /

Study Sample Code (1-2) ____ - (4-6) ____ - (8-12) ____ (State - County - Well Number)

State Sample # (14-24) ____

Well sampled: __Yes __No (26)

If not sampled, check most appropriate reason:

__Refusal(s) (R) __No well at location (W) __No resident(s) available (S) (38)

Latitude/longitude (42-43) (44-45) (46-47) / (49-51) (52-53) (54-55)

Person collecting sample: ____ (57-

Date & time of sample collection: (71-78) _/_/_ MM DD YY (80-83) __ __ hour min (24-hour time)

Contact person: (85-100) ____ Phone (101-112) (__ __) (AC) - __ __ __ - __ __

Location of well (address/distance from permanent markers): (113-1

Well depth (feet) ____ (171-173)

Well currently used for drinking water __Yes __No (174)

Standing surface-water within 100' during/after flood NA (A) Yes No (175)

Important!

Water samples mu

Centers for Disease Control and Prevention (CDC) .. National Center for Environmental Health (NCEH)

A Survey of the Quality of Water Drawn from Domestic Wells in Nine Midwest States:

Data Collection Form
Appendix 1 - Page 2

see also: Appendix 1 - Page 3

Contamination Midwestern States Affected by 1993 Flooding

Data Collection Form - Survey of Well Contamination
Midwestern States Affected by 1993 Flooding page 2

Study Sample Code ___ - ___ - ___ (State - County - Well Number)

State Sample # ______

Well capped: ___ Yes ___ No ___ ND (ND = Not Determined) (261)

[Key N for ND below]

Lid setting on top of casing: (check one)

___ Wood - solid sheet (S) ___ Wood - boards (B) ___ Concrete (C) ___ Metal (M) Other ______ (O) (262)

Cap secured to top of casing on the outside (standard cap)? ___ Yes ___ No ___ ND (263)

Cap secured to top of casing on the inside (sanitary seal)? ___ Yes ___ No ___ ND (264)

Is the well vented? ___ Yes ___ No ___ ND (265) If so, does the vent have a screen? ___ Yes ___ No (266)

Are there any openings between the lid and the casing? ___ Yes ___ No ___ ND (267)

Are there any holes or cracks in the casing? ___ Yes ___ No ___ ND (268)

Is there a tight seal with a grommet, caulking, or conduit (to the electric source) where electric line inlet goes through the cap? ___ Yes ___ No ___ ND (269)

Is there a standard pitless adaptor? ___ Yes ___ No ___ ND (270)

Type of pump: (check one)

___ Deep jet pump (D) ___ Shallow jet pump (H) ___ Pump jack/hand pump (P)

___ Submersible pump (U) ___ Centrifugal pump (C) ___ Turbine pump (T) Other ______ (O) (271)

Location of pump: (check one) ___ In the well (W) ___ In pumphouse (H) ___ In well pit (P) Other ______ (O) (272)

Is the well located down slope from any possible contamination sources within 100 feet? ___ Yes ___ No (273)

Are any back-flow prevention assemblies present? ___ Yes ___ No (274)

How far does the well casing extend above ground level: feet inches

ED_004892_00013674-00077

Centers for Disease Control and Prevention (CDC) ... National Center for Environmental Health (NCEH)

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A Survey of the Quality of Water Drawn from Domestic Wells in Nine Midwest States:

Data Collection Form
Appendix 1 - Page 3

see also: Appendix 1 - Pages 1 and 2

Data Collection Form - Survey of Well Contamination Midwestern States Affected by 1993 Flooding

Study Sample Code ____ - ____ - ____ (State - County - Well Number)

State Sample # ______

Number of adults and children currently living in household __ adults (>17) (302-303) __ Children (6-17) (305-306) __

Of those living in household, how many adults and children are currently drinking water from the well (do not count if all drinking water is boiled). __ adults (>17) (311-312) __ Children (6-17) (314-315) __

Of those drinking water from the well, how many have had diarrhea (3 or more loose or watery stools in one 24-hour period) in the last 2 weeks? __ adults (>17) (320-321) __ Children (6-17) (323-324) __

Commercial fertilizers ever used __Yes __No (329)

Distance used/mixed from well ______ feet (331-335) Date last used ____ Month (337-338)

Manure ever used __Yes __No (342)

Distance used/stored from well ______ feet (343-347) Date last used ____ Month (349-350)

Pesticides ever used __Yes __No (354)

A Survey of the Quality of Water Drawn from Domestic Wells in Nine Midwest States

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Appendix II - Definitions

Aquifer - a natural underground layer of porous, water-bearing materials which yields a large amount of water. They serve to store and transport water.

Coliform bacteria - all aerobic and facultative anaerobic, gram-negative, non-spore forming, rod shaped bacteria which ferment lactose with gas production within 48 hours at 35EC. E. coli is a member of the coliform bacteria.

Domestic well - a well with less than 15 service connections to households or regularly serves less than 25 people daily.

Down gradient - the direction that ground water flows: similar in concept to downstream for surface water, such as a river.

Drinking water - water that can be used for drinking, cooking, and washing and not cause adverse health effects.

Ground water - water below the water table.

Maximum Contaminant Levels - the maximum permissible level of a contaminant in water which is delivered to the free flowing outlet of the ultimate user of a public water system. This level is not associated with adverse health effects.

Monitoring - routine, standardized measurement and observation.

Most probable number - a mathematical estimate of the mean density of bacteria in a sample. This is based on the number of positive samples.

Odds ratio - is calculated by dividing the ratio of the odds of exposure (or well feature) among cases (or contaminated wells) to odds of exposure (or well feature) among controls (or uncontaminated wells). In regards to the well survey, the odds ratio reveals the strength of the association between a well feature (i.e., construction, design, condition, location, etc.) and presence of contaminants in the well water sample (coliform bacteria, E. coli, nitrate, or atrazine). An odds ratio less than one indicates that the well feature is associated with lower contamination rate; an odds ratio greater than one implies that the well feature is associated with a higher contamination rate; an odds ratio of one shows that the well feature is not associated with the contamination rate.

Public water supply - a system for the provision to the public of piped water for human consumption, if such system has at least 15 service connections or regularly serves an average of at least 25 individuals daily for at least 60 days of the year.

Sanitary survey - an onsite review of the water source, facilities, equipment, operation and maintenance of a water system for the purpose of evaluating the adequacy of such source, facilities, equipment, operation and maintenance for producing and distributing safe drinking water, and to evaluate potential sources for pollution of ground water.

Service connection - the junction between the water main and the line from the household served by the water purveyor.

Water supply system - the collection, treatment, storage, and distribution of potable water from source to consumer.

Wellhead - the portion of the well that projects above the ground surface.

Well construction types-

- **bored** - an auger bores a cylindrical hole into the earth. After water is reached, the well is usually cased with tile, steel pipe or other suitable material.
- **buried slab** - a transition joint that connects a large-bore diameter casing (>12 inches) to a small-bore diameter casing (<12 inches). This joint allows a standard casing to extend from the slab to the surface.
- **drilled** - a percussion or rotary tool digs the hole and a steel or plastic casing is placed into the hole.
- **driven or sandpoint** - a series of tightly coupled pipe lengths which are fitted with a well point at the lower end and driven into the ground. When the point reaches the water table, water flows into the pipe through the screened openings on the well point.
- **dug** - made by excavating a hole several feet in diameter to a depth just below the water table. The circular hole is usually lined with rocks, brick, wood, or concrete pipe to prevent cave-ins.

EXHIBIT 5

Rate of Nitrate Exceedances by Wisconsin County

County	People	Cows	Sq miles	People/ sq mile	Cows/ sq mile	Samples Exceeding Standard Nitrate Exceedances
Barron	45,883	24,500	862.71	53	28	15% +
Calumet	49,580	29,500	318.24	156	93	15% +
Dane	503,072	52,000	1197.24	420	43	15% +
Green	36,900	30,000	583.96	63	51	15% +
Jackson	20,608	13,200	987.72	21	13	15% +
Lafayette	16,855	29,500	633.59	27	47	15% +
Pepin	7,416	8,200	231.98	32	35	15% +
Pierce	41,009	15,900	573.75	71	28	15% +
Portage	70,721	13,500	800.68	88	17	15% +
Rock	160,331	12,500	718.14	223	17	15% +
Sauk	62,434	26,500	1257.31	50	21	15% +
Ashland	16,063	2,000	1045.04	15	2	0 - 5%
Bayfield	15,100	2,000	1477.86	10	1	0 - 5%
Brown	253,078	42,000	529.71	478	79	0 - 5%
Burnett	15,426	3,300	821.85	19	4	0 - 5%
Door	27,946	7,200	481.98	58	15	0 - 5%
Douglas	44,121	500	1304.14	34	0	0 - 5%
Forest	9,194	0	1014.07	9	0	0 - 5%
Iron	5,879	0	758.17	8	0	0 - 5%
Kewaunee	20,584	42,000	342.52	60	123	0 - 5%
Lincoln	28,875	4,200	878.97	33	5	0 - 5%
Menominee	4,256	0	357.61	12	0	0 - 5%
Oconto	37,744	20,000	997.99	38	20	0 - 5%
Oneida	35,940	0	1112.97	32	0	0 - 5%
Ozaukee	86,959	9,100	233.08	373	39	0 - 5%
Polk	43,979	15,800	913.96	48	17	0 - 5%
Price	14,024	4,200	1254.38	11	3	0 - 5%
Racine	195,224	3,600	332.5	587	11	0 - 5%
Rusk	14,657	11,500	913.59	16	13	0 - 5%
Sawyer	16,619	2,600	893.06	19	3	0 - 5%
Sheboygan	115,226	26,500	722.33	160	37	0 - 5%
Taylor	20,695	16,500	974.88	21	17	0 - 5%
Vilas	21,453	0	856.6	25	0	0 - 5%
Washburn	15,853	2,800	797.11	20	4	0 - 5%
Washington	132,804	14,400	430.7	308	33	0 - 5%
Waukesha	392,694	2,500	549.57	715	5	0 - 5%
Winnebago	168,539	14,900	434.49	388	34	0 - 5%
Adams	20,725	1,100	645.65	32	2	10.1 - 15%
Buffalo	13,528	18,300	671.64	20	27	10.1 - 15%
Chippewa	63,030	30,000	1008.37	63	30	10.1 - 15%
Columbia	56,753	15,900	765.53	74	21	10.1 - 15%
Iowa	23,764	23,500	762.58	31	31	10.1 - 15%
Juneau	26,800	10,600	766.93	35	14	10.1 - 15%
Monroe	45,279	25,500	900.78	50	28	10.1 - 15%
Vernon	30,079	24,500	791.58	38	31	10.1 - 15%
Waushara	24,441	5,000	626.15	39	8	10.1 - 15%
Clark	34,677	66,000	1209.82	29	55	5.1 - 10%
Dodge	88,807	39,500	875.63	101	45	5.1 - 10%
Dunn	43,974	21,500	850.11	52	25	5.1 - 10%
Eau Claire	100,548	10,200	637.98	158	16	5.1 - 10%
Florence	4,446	300	488.2	9	1	5.1 - 10%

	People/ sq mile	Cows/ sq mile
0 - 5%	86	12
5.1 - 10%	87	35
10.1 - 15%	44	22
15% +	124	31

EXHIBIT 5

Rate of Nitrate Exceedances by Wisconsin County

County	People	Cows	Sq miles	People/ sq mile	Cows/ sq mile	Samples Exceeding Standard Nitrate Exceedances
Fond du Lac	102,070	54,000	719.55	142	75	5.1 - 10%
Green Lake	19,057	7,500	349.44	55	21	5.1 - 10%
Jefferson	84,141	14,500	556.47	151	26	5.1 - 10%
Langlade	19,751	7,500	870.64	23	9	5.1 - 10%
Manitowoc	81,102	51,000	589.08	138	87	5.1 - 10%
Marathon	134,961	65,000	1544.98	87	42	5.1 - 10%
Marinette	41,648	11,800	1399.35	30	8	5.1 - 10%
Marquette	15,317	5,600	455.6	34	12	5.1 - 10%
Outagamie	179,830	38,000	637.52	282	60	5.1 - 10%
Saint Croix	85,645	19,700	830.9	103	24	5.1 - 10%
Shawano	41,793	37,000	511.27	82	72	5.1 - 10%
Trempeaieau	29,280	21,500	732.97	40	29	5.1 - 10%
Walworth	102,782	12,900	555.13	185	23	5.1 - 10%
Waupaca	52,361	23,000	747.71	70	31	5.1 - 10%
Wood	74,499	19,300	793.12	94	24	5.1 - 10%
Crawford	16,562	8,400	570.66	29	15	Insufficient data
Grant	51,801	45,000	1146.85	45	39	Insufficient data
Kenosha	167,314	3,300	271.99	615	12	Insufficient data
La Crosse	116,466	9,200	451.69	258	20	Insufficient data
Milwaukee	952,054	0	241.4	3944	0	Insufficient data
Richland	17,911	14,800	586.15	31	25	Insufficient data
WISCONSIN	5,730,937	1,265,000	54157	106	23	

People/ sq mile	Cows/ sq mile

Western Region	781,379
Northeastern Region	1,234,572
Northern Region	488,220
Southeastern Region	2,113,972
Southern Region	1,112,794

Population Source: Office of Health Informatics, Division of Public Health, Wisconsin Department of Health Services.

EXHIBIT 5

Ranked List of Cows Per Square Mile Correlated to Rate of Nitrate Exceedances

Rank by Cows/sq mi	People	Cows	Sq miles	People/ sq mile	Cows/ sq mile	
Kewaunee	20,584	42,000	342.52	60	123	0 - 5%
Calumet	49,580	29,500	318.24	156	93	15% +
Manitowoc	81,102	51,000	589.08	138	87	5.1 - 10%
Brown	253,078	42,000	529.71	478	79	0 - 5%
Fond du Lac	102,070	54,000	719.55	142	75	5.1 - 10%
Shawano	41,793	37,000	511.27	82	72	5.1 - 10%
Outagamie	179,830	38,000	637.52	282	60	5.1 - 10%
Clark	34,677	66,000	1209.82	29	55	5.1 - 10%
Green	36,900	30,000	583.96	63	51	15% +
Lafayette	16,855	29,500	633.59	27	47	15% +
Dodge	88,807	39,500	875.63	101	45	5.1 - 10%
Dane	503,072	52,000	1197.24	420	43	15% +
Marathon	134,961	65,000	1544.98	87	42	5.1 - 10%
Grant	51,801	45,000	1146.85	45	39	Insufficient data
Ozaukee	86,959	9,100	233.08	373	39	0 - 5%
Sheboygan	115,226	26,500	722.33	160	37	0 - 5%
Pepin	7,416	8,200	231.98	32	35	15% +
Winnebago	168,539	14,900	434.49	388	34	0 - 5%
Washington	132,804	14,400	430.7	308	33	0 - 5%
Vernon	30,079	24,500	791.58	38	31	10.1 - 15%
Iowa	23,764	23,500	762.58	31	31	10.1 - 15%
Waupaca	52,361	23,000	747.71	70	31	5.1 - 10%
Chippewa	63,030	30,000	1008.37	63	30	10.1 - 15%
Trempealeau	29,280	21,500	732.97	40	29	5.1 - 10%
Barron	45,883	24,500	862.71	53	28	15% +
Monroe	45,279	25,500	900.78	50	28	10.1 - 15%
Pierce	41,009	15,900	573.75	71	28	15% +
Buffalo	13,528	18,300	671.64	20	27	10.1 - 15%
Jefferson	84,141	14,500	556.47	151	26	5.1 - 10%
Dunn	43,974	21,500	850.11	52	25	5.1 - 10%
Richland	17,911	14,800	586.15	31	25	Insufficient data
Wood	74,499	19,300	793.12	94	24	5.1 - 10%
Saint Croix	85,645	19,700	830.9	103	24	5.1 - 10%
Walworth	102,782	12,900	555.13	185	23	5.1 - 10%
Green Lake	19,057	7,500	349.44	55	21	5.1 - 10%
Sauk	62,434	26,500	1257.31	50	21	15% +
Columbia	56,753	15,900	765.53	74	21	10.1 - 15%
La Crosse	116,466	9,200	451.69	258	20	Insufficient data
Oconto	37,744	20,000	997.99	38	20	0 - 5%
Rock	160,331	12,500	718.14	223	17	15% +
Polk	43,979	15,800	913.96	48	17	0 - 5%
Taylor	20,695	16,500	974.88	21	17	0 - 5%
Portage	70,721	13,500	800.68	88	17	15% +
Eau Claire	100,548	10,200	637.98	158	16	5.1 - 10%
Door	27,946	7,200	481.98	58	15	0 - 5%

EXHIBIT 5

Ranked List of Cows Per Square Mile Correlated to Rate of Nitrate Exceedances

Rank by Cows/sq mi	People	Cows	Sq miles	People/ sq mile	Cows/ sq mile	
Crawford	16,562	8,400	570.66	29	15	Insufficient data
Juneau	26,800	10,600	766.93	35	14	10.1 - 15%
Jackson	20,608	13,200	987.72	21	13	15% +
Rusk	14,657	11,500	913.59	16	13	0 - 5%
Marquette	15,317	5,600	455.6	34	12	5.1 - 10%
Kenosha	167,314	3,300	271.99	615	12	Insufficient data
Racine	195,224	3,600	332.5	587	11	0 - 5%
Langlade	19,751	7,500	870.64	23	9	5.1 - 10%
Marinette	41,648	11,800	1399.35	30	8	5.1 - 10%
Waushara	24,441	5,000	626.15	39	8	10.1 - 15%
Lincoln	28,875	4,200	878.97	33	5	0 - 5%
Waukesha	392,694	2,500	549.57	715	5	0 - 5%
Burnett	15,426	3,300	821.85	19	4	0 - 5%
Washburn	15,853	2,800	797.11	20	4	0 - 5%
Price	14,024	4,200	1254.38	11	3	0 - 5%
Sawyer	16,619	2,600	893.06	19	3	0 - 5%
Ashland	16,063	2,000	1045.04	15	2	0 - 5%
Adams	20,725	1,100	645.65	32	2	10.1 - 15%
Bayfield	15,100	2,000	1477.86	10	1	0 - 5%
Florence	4,446	300	488.2	9	1	5.1 - 10%
Douglas	44,121	500	1304.14	34	0	0 - 5%
Forest	9,194	0	1014.07	9	0	0 - 5%
Iron	5,879	0	758.17	8	0	0 - 5%
Menominee	4,256	0	357.61	12	0	0 - 5%
Oneida	35,940	0	1112.97	32	0	0 - 5%
Vilas	21,453	0	856.6	25	0	0 - 5%
Milwaukee	952,054	0	241.4	3944	0	Insufficient data

EXHIBIT 5

Ranked List of People Per Square Mile Correlated to Rate of Nitrate Exceedances

Rank by People/sq mi	People	Cows	Sq miles	People/ sq mile	Cows/ sq mile	
Milwaukee	952,054	0	241.4	3944	0	Insufficient data
Waukesha	392,694	2,500	549.57	715	5	0 - 5%
Kenosha	167,314	3,300	271.99	615	12	Insufficient data
Racine	195,224	3,600	332.5	587	11	0 - 5%
Brown	253,078	42,000	529.71	478	79	0 - 5%
Dane	503,072	52,000	1197.24	420	43	15% +
Winnebago	168,539	14,900	434.49	388	34	0 - 5%
Ozaukee	86,959	9,100	233.08	373	39	0 - 5%
Washington	132,804	14,400	430.7	308	33	0 - 5%
Outagamie	179,830	38,000	637.52	282	60	5.1 - 10%
La Crosse	116,466	9,200	451.69	258	20	Insufficient data
Rock	160,331	12,500	718.14	223	17	15% +
Walworth	102,782	12,900	555.13	185	23	5.1 - 10%
Sheboygan	115,226	26,500	722.33	160	37	0 - 5%
Eau Claire	100,548	10,200	637.98	158	16	5.1 - 10%
Calumet	49,580	29,500	318.24	156	93	15% +
Jefferson	84,141	14,500	556.47	151	26	5.1 - 10%
Fond du Lac	102,070	54,000	719.55	142	75	5.1 - 10%
Manitowoc	81,102	51,000	589.08	138	87	5.1 - 10%
Saint Croix	85,645	19,700	830.9	103	24	5.1 - 10%
Dodge	88,807	39,500	875.63	101	45	5.1 - 10%
Wood	74,499	19,300	793.12	94	24	5.1 - 10%
Portage	70,721	13,500	800.68	88	17	15% +
Marathon	134,961	65,000	1544.98	87	42	5.1 - 10%
Shawano	41,793	37,000	511.27	82	72	5.1 - 10%
Columbia	56,753	15,900	765.53	74	21	10.1 - 15%
Pierce	41,009	15,900	573.75	71	28	15% +
Waupaca	52,361	23,000	747.71	70	31	5.1 - 10%
Green	36,900	30,000	583.96	63	51	15% +
Chippewa	63,030	30,000	1008.37	63	30	10.1 - 15%
Kewaunee	20,584	42,000	342.52	60	123	0 - 5%
Door	27,946	7,200	481.98	58	15	0 - 5%
Green Lake	19,057	7,500	349.44	55	21	5.1 - 10%
Barron	45,883	24,500	862.71	53	28	15% +
Dunn	43,974	21,500	850.11	52	25	5.1 - 10%
Monroe	45,279	25,500	900.78	50	28	10.1 - 15%
Sauk	62,434	26,500	1257.31	50	21	15% +
Polk	43,979	15,800	913.96	48	17	0 - 5%
Grant	51,801	45,000	1146.85	45	39	Insufficient data
Trempealeau	29,280	21,500	732.97	40	29	5.1 - 10%
Waushara	24,441	5,000	626.15	39	8	10.1 - 15%
Vernon	30,079	24,500	791.58	38	31	10.1 - 15%
Oconto	37,744	20,000	997.99	38	20	0 - 5%
Juneau	26,800	10,600	766.93	35	14	10.1 - 15%
Douglas	44,121	500	1304.14	34	0	0 - 5%

EXHIBIT 5

Ranked List of People Per Square Mile Correlated to Rate of Nitrate Exceedances

Rank by People/sq mi	People	Cows	Sq miles	People/ sq mile	Cows/ sq mile	
Marquette	15,317	5,600	455.6	34	12	5.1 - 10%
Lincoln	28,875	4,200	878.97	33	5	0 - 5%
Oneida	35,940	0	1112.97	32	0	0 - 5%
Adams	20,725	1,100	645.65	32	2	10.1 - 15%
Pepin	7,416	8,200	231.98	32	35	15% +
Iowa	23,764	23,500	762.58	31	31	10.1 - 15%
Richland	17,911	14,800	586.15	31	25	Insufficient data
Marinette	41,648	11,800	1399.35	30	8	5.1 - 10%
Crawford	16,562	8,400	570.66	29	15	Insufficient data
Clark	34,677	66,000	1209.82	29	55	5.1 - 10%
Lafayette	16,855	29,500	633.59	27	47	15% +
Vilas	21,453	0	856.6	25	0	0 - 5%
Langlade	19,751	7,500	870.64	23	9	5.1 - 10%
Taylor	20,695	16,500	974.88	21	17	0 - 5%
Jackson	20,608	13,200	987.72	21	13	15% +
Buffalo	13,528	18,300	671.64	20	27	10.1 - 15%
Washburn	15,853	2,800	797.11	20	4	0 - 5%
Burnett	15,426	3,300	821.85	19	4	0 - 5%
Sawyer	16,619	2,600	893.06	19	3	0 - 5%
Rusk	14,657	11,500	913.59	16	13	0 - 5%
Ashland	16,063	2,000	1045.04	15	2	0 - 5%
Menominee	4,256	0	357.61	12	0	0 - 5%
Price	14,024	4,200	1254.38	11	3	0 - 5%
Bayfield	15,100	2,000	1477.86	10	1	0 - 5%
Florence	4,446	300	488.2	9	1	5.1 - 10%
Forest	9,194	0	1014.07	9	0	0 - 5%
Iron	5,879	0	758.17	8	0	0 - 5%

EXHIBIT 6

Pumper

Editorial > **Tanks Look Like Swiss Cheese**

Tanks Look Like Swiss Cheese

By Scottie Dayton | Interview | August 2008

Wisconsin waterfront communities committed to replacing leaky steel septic tanks

Central Wisconsin and communities along Lake Michigan's shoreline experienced a building boom from the 1970s to 1990s. Steel septic and holding tanks, many from a now-defunct company, TMC Inc., were installed for new and replacement onsite systems. TMC offered several grades of tanks based on wall thickness. According to Chris Olson, assistant sanitarian for the Door County Sanitarian's Department, most installers purchased the lighter, 1/8-inch-thick tanks, as they loaded easily for transport.

Within 15 to 20 years, sometimes sooner, the tar-coated tanks became pitted on the bottom and sides, and especially above the liquid level and around the riser where gases reacted with the metal. The rate of corrosion was more pronounced in sandy soils because of their iron content and the way positive and negative ions form. Top covers and baffles rusted away, and only the biomat coating the interiors prevented the tanks from caving in.

When Wisconsin's revised sanitary code required septic tank maintenance, dozens of metal tanks collapsed after the pump-out. The failure was often catastrophic, with the top collapsing into the tank, leaving an open cylinder. Last summer, a Kangaroo Lake resident on a riding lawn mower fell into a septic tank. The back wheels of a pickup truck experienced the same fate on property elsewhere. During an inspection, an assistant sanitarian's leg became stuck when his foot broke through the ground and the top of a tank.

In 2002, the Door County Sanitarian's Department began its Sanitary Survey, inspecting 300 or more onsite systems from top to bottom every year. Until the county began generating hard data, the state had only anecdotal evidence about onsite systems with steel tanks. In the last two to three years, the department has become aggressive about the program after seeing 80 to 90 percent of the tanks come out of the ground looking like Swiss cheese.

Olson regulates the state's onsite wastewater program in Door County, educates homeowners, and is part of the survey team.

Pumper:

What were the results of the 2007 Sanitary Survey?

Olson:

We found that 26 percent of 373 inspected systems were failing, and 49 percent of those failures were due to bad tanks. Of the failed tanks, 96 percent were steel, and 82 percent of them were made by TMC Inc., which is out of business. About

20 percent of about 16,000 systems in Door County still have steel tanks.

The issue is gaining notoriety as people see the extent of corrosion. Articles in our local newspaper have alerted the people and they are concerned. Residents don't want to be responsible for polluting their groundwater.

Pumper:

Don't homeowners with leaking tanks notice ponding or other evidence of the problem?

Olson:

Most counties that are replacing these tanks have noted that they're holding water only because a biomat forms in the soil around the leaks. According to pumpers, the tar coating and biomat holds pitted tanks together to a certain degree. The only way to see the holes is to pressure wash the tank or dig around it to look at the exterior.

Holding tanks installed in floodplains were anchored with concrete to prevent floatation. When they begin to leak, they're full all the time. For example, a steel tank installed in 1995 was replaced in 2000 because it had to be pumped out every three days or so.

Pumper:

Are contractors still using steel tanks, and if not, what are they using as replacements?

Olson:

Very few contractors install (steel tanks) now, and those that do claim to be saving property owners money. No one in Door County installs them, so the market has corrected itself.

Septic and holding tanks must withstand harsh environments, and steel tanks should not be allowed. The problem is that state statutes prohibit counties from banning them or ordering their removal if they aren't failing.

Installers are switching to polyethylene and fiberglass tanks when sites are inaccessible for precast concrete, and it appears that plastic will last underground provided minimal cover is maintained.

Pumper:

When leaking tanks are discovered, what does the county do about them?

Olson:

Following our investigation, we issue an order to the property owner to replace the tank or system. Door County's policy states that most failing systems serving single-family homes must be replaced within one year. The situation may be handled differently with public facilities. If property owners meet certain financial criteria, the Wisconsin Fund Grant Program provides assistance to replace their onsite systems.

Pumper:

Besides environmental issues, are these leaking tanks causing other problems?

Olson:

Not really. Environmental issues are of great concern for our area. Door County has been called the Cape Cod of the Midwest for years, and with nearly 300 miles of shoreline, it remains a strong tourist-based economy. Good water quality is our lifeblood. As the media shows these corroded tanks, it's easier to convince people that manufactured goods won't last forever.

Steel tanks were installed all over Wisconsin. As their condition is evaluated, it may be necessary to raise the public's awareness level statewide. I say "may," because some steel tank manufacturers made a quality product.

Pumper:

What can pumpers do to diagnose these problems?

Olson:

We're encouraging the use of high-resolution cameras to inspect the tanks. In some situations, a probe can test the steel's integrity. When our survey team does an inspection with the homeowners standing by, the digital display from the camera is one of the best tools we have. We then show them pictures of other steel tanks of similar age, after which most agree that their corroded tank should be replaced.

If pumpers in other counties or states see tanks hanging on by a thread, regulatory bodies need to know about the situation to begin drafting a policy that looks at it. For example, most of Wisconsin isn't looking at old systems because it doesn't recognize that there is a problem. But this is a Catch 22, because pumpers who want to stay in business do not turn in all their bad clients. Besides anonymous tips, pumpers should provide information about these steel tanks and their limited life span to Realtors, homeowners, and plumbing contractors.

Pumper:

After an article in the Door County Advocate about your survey, did homeowners voluntarily report their steel tanks?

Olson:

We had a great response, and many property owners asked what steps to take to replace their tanks. It was reassuring to see people doing this on their own.

The article prompted the Door Property Owners Association to ask us to give a presentation about the Sanitary Survey. The association also suggested that we display a corroded steel tank at this year's county fair, which we'll try to do. This group and others asked that we continue publicizing the issue and educating homeowners.

Any group willing to go public about an issue carries a lot of weight, because it reinforces the elected officials' decisions to create the Sanitary Survey and time-of-sale program, which evaluates systems before properties change ownership. Those two programs enable us to look at almost 1,000 systems a year.

Our office is talking about sending a letter to all known steel tank property owners containing the results of our Sanitary Survey and pictures of these tanks. That should stimulate a good response.

Without education, regulatory programs generate bad feelings. Even contractors, pumpers, and plumbers must believe that they're doing the right thing. It sounds euphoric, but this industry is held together only by the people in it. If we want to accomplish something, everybody has to be in it together. We can't afford issues that divide our industry.

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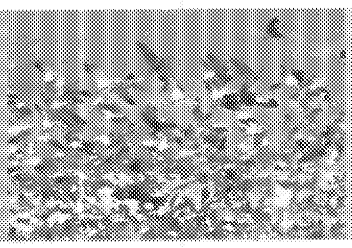
EXHIBIT 7

SEPTIC SYSTEM IMPACT ON SURFACE WATERS

A Review for the Inland Northwest



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June 2005

Septic System Impact on Surface Water is a publication of Tri-State Water Quality Council, which recognizes the following individuals for their valuable work in researching, drafting, editing, and/or compiling information, graphics, and photographs for this report and thanks them for making its publication possible:

Will McDowell
Chris Brick
Matt Clifford
Michelle Frody-Hutchins
Jon Harvala
Karen Knudsen

TRI-STATE

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INTRODUCTION

Montana, Idaho, Washington, and Oregon have experienced tremendous population growth in the past 15 years, and this growth is expected to continue. To many people's surprise, a great deal of this growth is occurring in rural areas without centralized infrastructure, such as sewage treatment plants. This rural growth tends to be concentrated near rivers and lakes, where increased wastewater loads can threaten water quality. One of the biggest challenges facing state and local governments is how to deal with the increase in wastewater while protecting the water quality that is crucial to the natural beauty of these areas.

Septic systems, also known as "on-site wastewater treatment systems," are widely used in rural and suburban settings to dispose of wastewater. When operating properly, septic systems remove many pollutants and provide some measure of protection for human health and for the environment. But as rural populations grow and aquifers exhaust their ability to dilute wastes from ever-increasing numbers of septic tanks, water quality steadily deteriorates. Most state and local governments have regulations designed to protect public health from the worst contaminants from septic systems: water-borne pathogens and nitrates. But very few governments have created effective measures to address the increasing threat that septic tanks pose to the ecosystems of rivers and lakes.

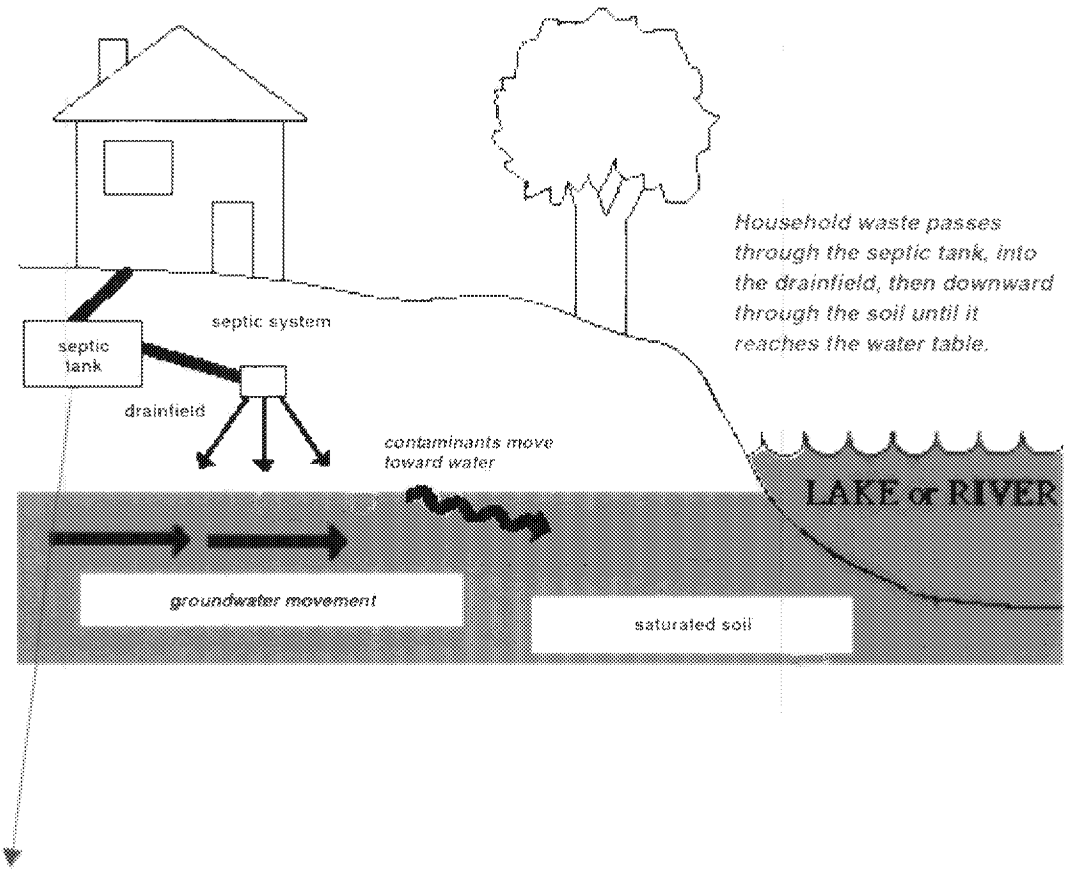
Why have communities not done more to prevent septic systems from harming our streams and lakes? Perhaps because in the past, when rural populations were lower, the impacts were minimal and there was little threat to our surface waters. Or it may be that the connection between groundwater and streams (or lakes) was simply not well understood. But scientists have demonstrated that septic wastes in groundwater do ultimately flow into rivers or lakes, and that in many areas these wastes are already degrading the quality of nearby waters. The goal of this paper is to discuss this issue by examining the technical background of the problem, clarifying the risks, and reviewing options for mitigation.

Through a review of scientific and policy studies, this paper will discuss the following questions:

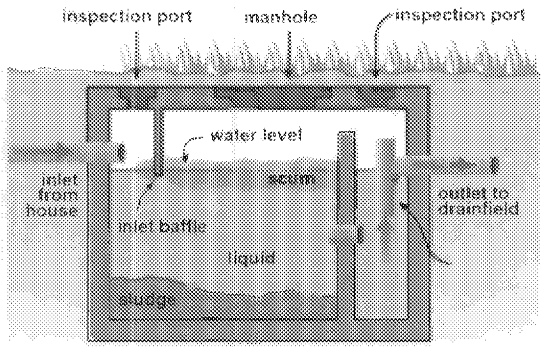
- What risk does septic effluent pose to streams and lakes?
- How do contaminants get from septic systems to groundwater?
- How do contaminants get from groundwater to streams and lakes?
- What are the wastewater treatment options when trying to achieve public health and resource protection goals?
- What are the existing policy and regulatory options for mitigating surface water impacts?

This paper is intended to give policymakers a broader appreciation of the risks that traditional septic systems pose to our surface waters, in the hope that this will lead them to develop strategies that maintain and improve the water quality of our lakes and rivers.

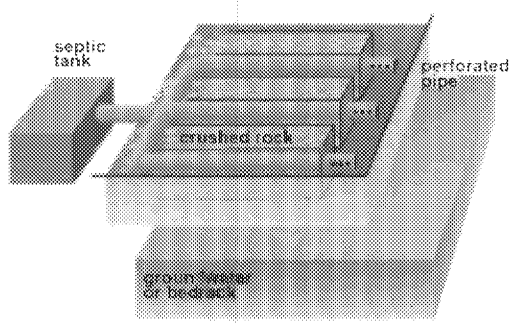
Waste's Journey from House to Water Table to Lakes and Streams



Up close: Septic Tank



Up close: Drainfield



SEPTIC EFFLUENT: What risk does it pose to streams and lakes?

Septic systems discharge a variety of contaminants which can affect surface waters, including nutrients, pathogens, organic matter and solids. Conventional septic tank and drainfield systems treat wastewater by settling solids and partly digesting the organic matter, allowing liquid effluent, which still contains nutrients and pathogens (bacteria, protozoa and viruses) to be discharged into the soil beneath the drainfield.

In the soil, biological processes, filtration, and adsorption remove most pathogens and some nutrients. However, conventional septic systems are not adequate for removing nitrate, and only partly remove phosphorus, certain pathogens, and certain other compounds, especially where soils or ground water conditions are marginally suitable, or where septic system densities are too high (EPA, 2002). Anything that is not removed by the soil under the drainfield will end up in groundwater.

Nutrient enrichment and its effect on lakes and rivers:

Septic systems are among the many sources of nutrients in groundwater and surface water—other major sources include agricultural fertilizers, livestock manure, air pollution, forest fires, eroded sediments, municipal wastewater, and storm-water runoff. Nutrient enrichment, or eutrophication, is the over-fertilization of surface waters by nitrogen and phosphorus, and is one of the leading causes of pollution of lakes, rivers, and coastal bays in the United States (EPA, 2004***).

Nutrient enrichment can cause a host of negative ecological effects on streams and lakes, including loss of water clarity, proliferation of aquatic weeds, algae blooms, and drop-offs in dissolved oxygen (a critical factor for fish and other aquatic life). Algae blooms can also make drinking water taste and smell bad, can release toxins (in the case of blue-green algae), and can contribute to the problem of carcinogenic tri-halomethanes formed by chlorination of drinking waters high in organic detritus (Carpenter, et.al., 1998, "Nonpoint Pollution of Surface Waters with N&P", Ecological Society of America, http://esa.sdsc.edu/).

Nitrogen, in its nitrate form, is also a direct risk to human and livestock health if it reaches high concentrations in drinking water (10 milligrams/Liter is the EPA maximum contaminant level for drinking water). However, the levels of nitrogen and phosphorus that cause ecological damage in lakes and rivers are far lower--usually more than 10 times lower--than the levels which are toxic to humans and livestock. Therefore, the precautions taken by communities to prevent nitrate toxicity in groundwater used for drinking, are not sufficient for preventing the negative ecological effects of nutrients that reach rivers and lakes.

Septic systems can contribute nutrients to surface waters, especially nitrogen, while associated development activities—e.g., construction, roads, lawns—increase phosphorus. The combination threatens sensitive waters.

The issue of "limiting nutrients" in lakes and rivers:

Some state and local governments assume that phosphorus is the only nutrient of concern for surface water pollution, but this is not the case. In lakes and rivers a certain ratio of nitrogen to phosphorus is required to trigger an algal bloom or excessive growth of aquatic plants, and the nutrient which is in shortest supply is known as the "limiting nutrient." In freshwater systems, the limiting nutrient is often, but not always, phosphorus. In parts of the Clark Fork River, for example, nitrogen is the limiting nutrient.

Nitrogen from septic systems can cause nutrient enrichment in fresh water if:

1) complementary sources of phosphorus are available, or could become available, such as phosphorus associated with soil erosion, phosphorus associated with wildfires, phosphorus from municipal/industrial wastewaters; or phosphorus in urban and suburban storm runoff; and/or
2) septic-derived phosphorus can reach surface water, which is more likely when the septic system is very close to a stream or lake, as in a lake-front home. Note that many of these sources of phosphorus increase with development.

Rural and suburban regions experiencing growth near lakes and rivers:

Much of the northwestern United States has experienced accelerated growth rates in the last 15 years, including many formerly rural counties in Idaho, western Montana, Oregon and Washington. The statewide growth in Idaho, Oregon, and Washington was far higher than the national average in 1990 to 2000, as was growth in western Montana. Much of this growth is concentrated near well-known rivers and lakes or coastal waters. The counties listed in Table 1 below experienced growth rates more than ***double the national average*** of 13% during 1990-2000.

Table 1: Fast-Growing Counties in the Northwest USA

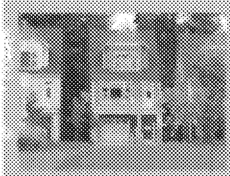
State/County	Growth Rate, 1990 - 2000	Key Surface Waters & Tributaries:
MT- Gallatin Co.	34%	Gallatin River and tributaries
MT- Ravalli Co.	44%	Bitterroot River and tributaries
MT- Lake Co.	26%	Flathead Lake and river
MT- Flathead Co.	26%	Flathead Lake, Swan Lake, Whitefish Lake, many others
ID- Kootenai Co.	56%	Spokane River, Coeur d'Alene & other lakes
ID- Bonner Co.	38%	Pend Oreille Lake
ID- Ada, Canyon, Elmore & Boise Cos	37 - 90%	Boise River, Payette River, Snake River and reservoirs
ID- Teton Co	74%	Upper Snake River
OR- Crook, Deschutes, Jefferson Cos.	36% - 54%	Deschutes River and tributaries
OR- Yamhill & Washington Cos.	30% - 43%	Willamette and tributaries
WA- Whatcom, Skagit, Snohomish & Thurston	29% - 30%	Nooksak, Skagit, Skykomish, Stillaguamish rivers, lakes, Puget Sound
WA- Benton, Franklin, & Grant Cos	27% - 36%	Yakima River, Columbia River, various lakes
WA- Stevens & Pend Oreille Cos.	27% - 32%	Spokane and Pend Oreille Rivers, Roosevelt Lake
WA- Chelan Co.	27%	Columbia tributaries & lakes

Source: U.S. Census Quickfacts

Of these high growth counties, only a few are associated with major metropolitan areas; most are associated with smaller cities or small towns. In these rural and suburban counties, much of the development is in un-sewered areas on septic systems. The 1990 census indicated that between 29% and 37% of state residents in Montana, Idaho, Washington, and Oregon used septic systems (EPA, 2002, OWTS). It is likely that a much greater percentage of the new residents in rural counties are using septic systems.

Data from county health departments in rural areas (shown in Charts 1 and 2 below) illustrates the rapid growth in number of septic systems in the fast-growing counties of the inland northwest. These data illustrate the rapid growth of septics, many of which are located near the area's beautiful lakes and rivers, or are situated over alluvial aquifers closely connected to surface waters:

The question posed by this phenomenal growth in septic systems is this: Does the discharge of contaminants from these systems into shallow groundwater also impose a large additional load of nitrates and other contaminants on our rivers and lakes? This paper examines the question of how this growth in septic systems puts surface water quality at risk.



157,000 people in the Clark Fork basin of Montana use septic systems

144,000 people in the Clark Fork basin are on sewer/wastewater treatment plants

52% of the people in the Clark Fork basin are on septics

—based on data from 10 counties

Chart 1: Number of Septic Systems Approved in Panhandle Health District, ID, 1976-2000

(includes Kootenai, Bonner, Benewah, Boundary, and Shoshone counties)

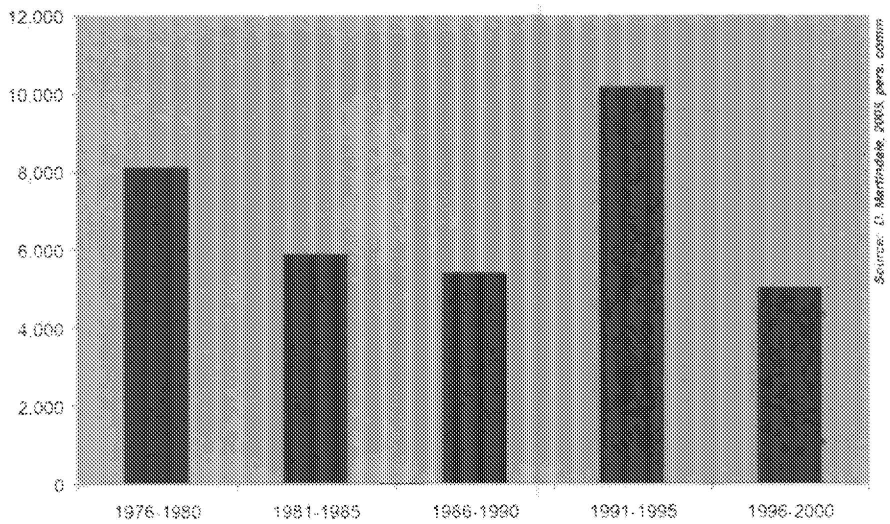
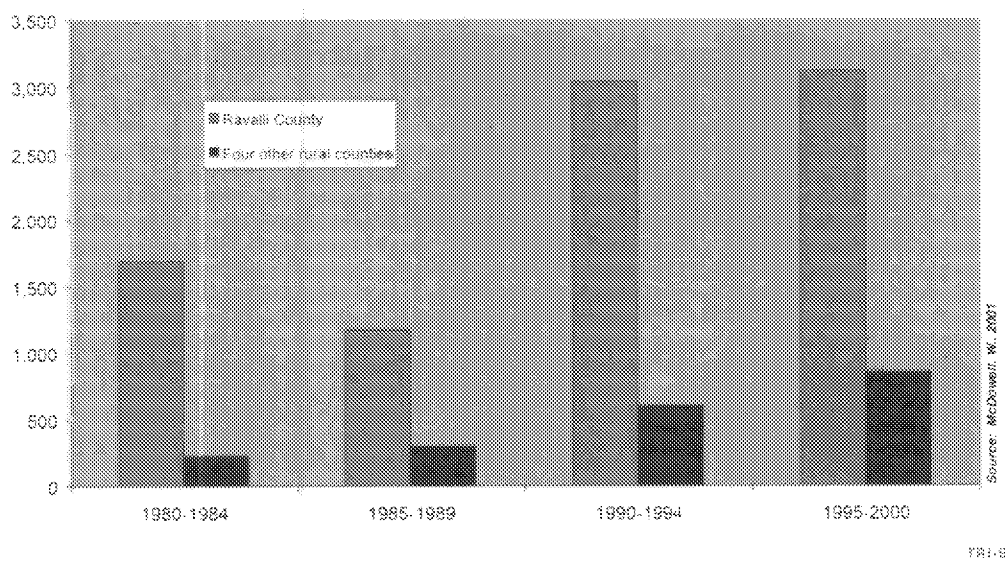


Chart 2: Number of Septic System Approvaled in Rural Clark Fork Basin Counties, MT, 1980-2000



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Examples of waters with water quality issues related to septic systems:

A number of important water bodies in the Northwest already have nutrient enrichment problems, and in some cases septic systems have been implicated as a significant source of those nutrients. Examples include:

- *Clark Fork River, Missoula County, MT:* The Missoula County Health Department and Missoula Valley Water Quality District have documented a large impact of septic systems discharging into the Missoula valley aquifer and then into the Bitterroot and Clark Fork rivers. The total load of nutrients (both nitrogen and phosphorus) discharged by groundwater in the Missoula valley is estimated to be approximately 40% of the TMDL nutrient load allocation for the Clark Fork River below the Bitterroot confluence (VNRP, 1998). Reducing this groundwater nutrient load by expanding sewers is a major goal of the Voluntary Nutrient Reduction Program for the Clark Fork (Missoula Valley Water Quality District, "Evaluation of Unsewered Areas in Missoula, MT", Missoula City-County Health Dept., 1996).

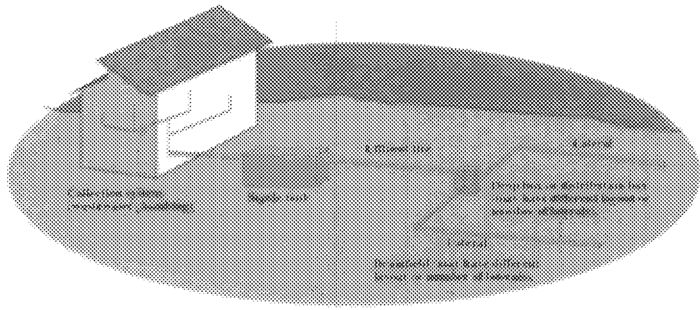
- *Lake Pend Oreille, Bonner County, ID:* Studies done by Idaho's Dept. of Environmental Quality have demonstrated that nutrient concentrations and resulting algae in the near-shore waters of Lake Pend Oreille are partly due to unsewered lake-front properties leaking septic effluent into the Lake. Efforts are underway to sewer lake-front communities, and avoid discharging treated wastewater into the Lake (Idaho Division of Environmental Quality. Phase I Diagnostic and Feasibility Analysis: A Strategy for Managing the Water Quality of Pend Oreille Lake. Bonner and Kootenai Counties, ID. Coeur d'Alene, ID. 1993).

- *Clackamas River, Clackamas County, OR:* High algal biomass has been documented as a recent phenomena on the lower Clackamus River, a mostly forested watershed upstream from Portland, Oregon. The highest algal counts, as well as the highest N and P concentrations, were measured on Sieben Creek, the site of recent urbanization. It's likely that a combination of urban storm-water runoff and septic system inputs are responsible for a significant part of this problem (Carpenter, Kurt. 2003. USGS Water Resource Investigations Report 02-4189, "Water Quality and Algal Conditions in the Clackamas River Basin, Oregon, and their Relations to Land and Water Management").

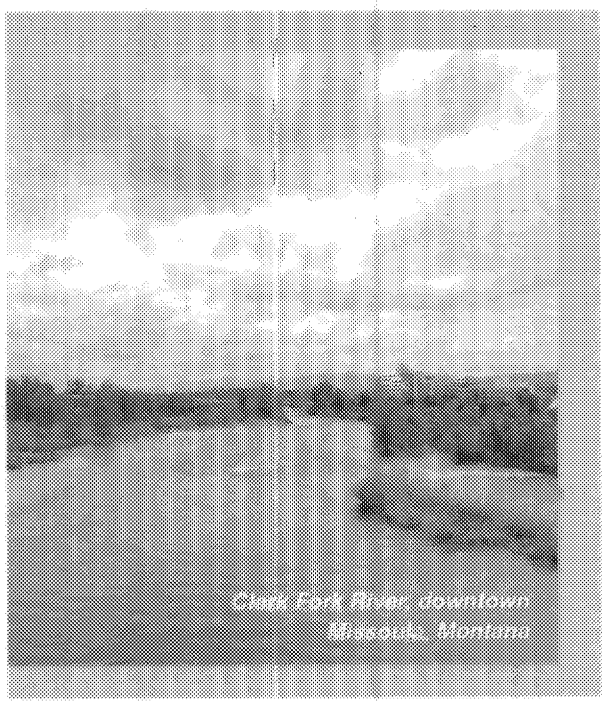
Septic system contamination of surface waters is a different, less well-known issue than the typical human health issue addressed by most current septic system regulation.

THE PATH OF CONTAMINATION:
How do contaminants get from septic systems to groundwater?

Wastewater leaving the drainfield of a septic system trickles first to unsaturated soil above the water table, and eventually to the water table below. The distance between drainfield and groundwater is not a determining factor—all continuously operated septic systems are expected to discharge to groundwater eventually (Woessner, 2001 newsletter). Where the depth to the water table is shallow and overlying soils are permeable, as is typical in valleys near streams, rivers, or lakes within the inland Northwest, recharge from septic systems to groundwater is relatively rapid. Although it is possible for wastewater to be absorbed by plant roots, in reality this rarely happens because properly-designed drainfields are installed below the root zone of grasses and outside the rooting areas of trees. Therefore, most septic effluent reaches the water table. This water carries with it some of the soluble contaminants of effluent that are not absorbed by soil, including nitrogen, various bacteria and



Typical Onsite Wastewater Treatment System



Clark Fork River downtown Missoula, Montana

Removal of Pollutants through Septic System Treatment of Wastewater:

Conventional septic systems consist of two primary components: the septic tank, which initially receives the wastewater, and the drainfield, which is the underground area that receives the outflow from the septic tank. The septic tank provides primary treatment to the wastewater by settling solids, and trapping greases, oils, and other floatable matter. Solid materials are partially converted to liquids by biological processes at the bottom of the tank. The liquid effluent is discharged into the drainfield. Further treatment occurs below the drainfield as the effluent percolates downward, in a micro-biologically active area known as a bio-mat. This area further treats the wastewater, trapping solids and metabolizing some nutrients and carbon. The bio-mat typically controls the infiltration rate in coarse or medium-textured soils, and treated effluent passes down through a partly-oxygenated unsaturated zone before reaching groundwater.

When a conventional septic system is properly designed, operated, and maintained, it is capable of nearly complete removal of suspended solids, bio-degradable organic compounds, and fecal coliforms. (EPA, 2002). However, conventional systems are not able to completely remove several of the constituents typically found in wastewater. Table 2 summarizes the effectiveness of typical septic tank and drainfield systems in removing common constituents.

is common for this process to remove 85-95% of phosphorous, and complete removal typically occurs long before effluent reaches surface water. However, this is not always the case—particularly where soils are coarse and distances to surface water are short. Significant phosphorus has been detected in groundwater below some drainfields, and phosphorus plumes have been measured moving down-gradient from septic drainfields in sandy shallow aquifers (Harman et.al. 1996, Ver Hey, 1987).

Conventional septic systems are also generally quite effective in removing pathogenic bacteria

Table 2: Wastewater Efffluent Constituents and Treatment Efficiency in Soil

Constituent	Effluent content (leaving tank), mg/L	Removal after percolation and treatment in a 3-5 foot vertical infiltration zone*
Biochemical Oxygen Demand	140 - 200	>90%
Nitrogen	40 - 100	10 - 20%
Phosphorus	5 - 15	0 - 100% (often 85 - 95%)
Fecal coliform bacteria	106 - 108	>99.99%
Organic chemicals (solvents, pesticides, etc.)	trace	>99%

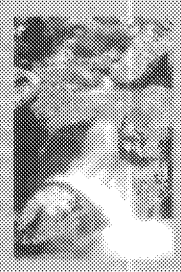
Source: EPA, 2002 Tables 3-7 and 3-17 and 3-19

As the table makes clear, a major weakness of conventional septic systems is the inability to effectively treat nitrogen. Once septic effluent enters the soil profile below the drainfield, almost all the nitrogen is converted by nitrification to nitrate (NO3). Nitrate is a very soluble chemical, which is transported readily in dissolved form into and through the groundwater and ultimately to surface water. Thus it should come as no surprise that one of the biggest concerns in areas with large numbers of septic systems is high nitrogen levels in surface and groundwater.

On the other hand, one of the major strengths of septic systems in general is the ability to treat phosphorous. Phosphorus in wastewater effluent tends to attach itself, or sorb to soil particles in the unsaturated zone below septic drainfields. It

and viruses via infiltration and treatment below the drainfield. Once again, however, this treatment is not perfect. Outbreaks of groundwater borne pathogens linked to septic systems have been documented in several locations in the Northwest. Over 400 people were infected with gastroenteritis related to contaminated groundwater in Flathead County, Montana, in 1995; an outbreak of typhoid fever in Yakima County, Washington, 1981, was related to a septic system contaminating a shallow well; and a number of major outbreaks of gastroenteritis have been attributed to groundwater borne Norwalk-like virus in numerous states (Missoula Valley Water Quality District, 1996). Other pathogens of concern in wastewater effluent are protozoans like Cryptosporidium and Giardia. Improperly constructed drainfields, high water tables, or inappropriate geologic settings (fractured

OTHER CONSTITUTENTS OF WASTEWATER



Surfactants are chemicals which are used in laundry detergents and other cleaning products to decrease the surface tension of water, and they are present in septic system effluent. The most common surfactants in household laundry detergents are linear akylbenzenesulfonate (LAS) and akylbenzenesulfonate (ABS). Surfactants can be readily bio-degraded by micro-organisms in aerobic conditions and possibly in saturated sediments. Concerns with surfactants include their ability to decrease adsorption and even actively desorb organic pollutants like trichlorobenzene from soils, and their deleterious effects on soil structure and infiltration rates (EPA, 2002).

Various chemicals known as "endocrine disruptors" have been detected in domestic wastewater. These chemicals, including bisphenol A (BPA) which is widely used in dental materials and plastic food and beverage containers, can interfere with the natural sex hormones in the body of fish and amphibians. Estradiol, a synthetic estrogen used in birth-control pills, is often found in domestic wastewater, and has been shown to cause major alterations in the sexuality of fish at extremely low concentrations (Kidd, K., 2003. Canadian Freshwater Institute). It has not yet been established whether the most common endrocrine disruptors are retained in soil during septic effluent filtration and treatment.

bedrock or karst systems) can allow pathogenic bacteria and viruses to reach groundwater, where they can survive for days and travel up to 30 meters.

Wastewater flow rates:

To get an idea of the combined impacts that septic systems in an area might have on adjacent waters, one must first estimate the amount of effluent typically discharged by each system, and the typical concentration of nitrogen. These numbers allow one to calculate the total amount, or load of nitrogen that can potentially reach adjacent waters.

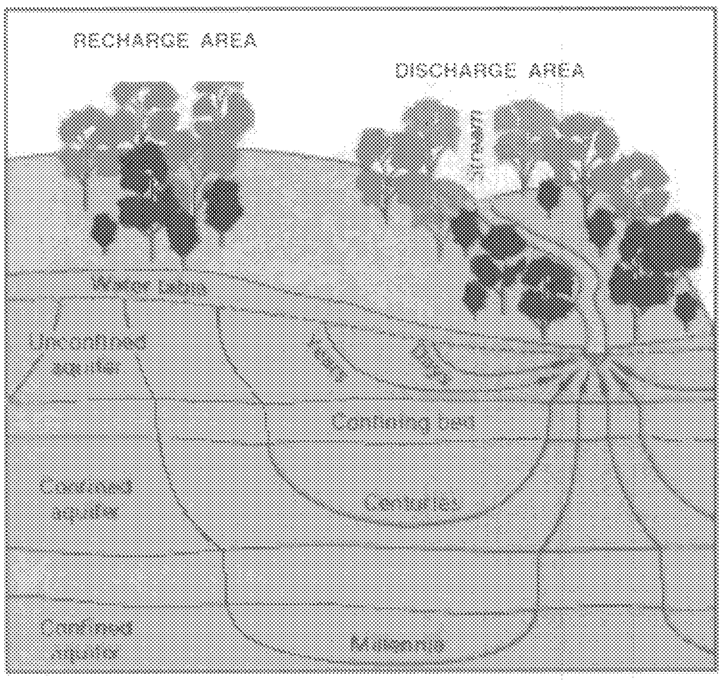
The load to soils below a typical septic drainfield is estimated to be 25 lbs of nitrate and 4 lbs of ortho-phosphate annually. Some of these nutrients—particularly phosphorous—are further removed by biological, geochemical, and physical filtering processes in the soil below the drainfield. This process is quite variable depending on the type of soil, depth to groundwater, loading rate, age of system and other factors. The performance of soil filtration in removing nutrients below septic drainfields ranges from 10 to 40 percent for total nitrogen and from 85 to 95 percent for total phosphorus. Using these numbers, one can reasonably estimate that a typical septic system discharges a total load of 19 lbs/year of nitrate and 0.4 lbs/year of orthophosphate to groundwater.

Not surprisingly, then, septic systems are the most frequently reported source of groundwater contamination in the U.S., and the single largest source, by volume, of wastewater discharged to groundwater. Nitrate is the primary contaminant that septic systems contribute to groundwater, and nitrate contamination in groundwater below septic drainfields is documented by an enormous literature. Studies have shown that groundwater nitrate loads and concentrations increase in areas with a high density of septic systems. In Helena, Montana, for example, a study has found that, between 1990 and 1994, average nitrate concentrations increased by 2.5% from an average of 1.25 mg/l to 1.70 mg/l as numbers of septic systems increased by 26% from 2,475 to 3,081.

SURFACE WATERS: How do contaminants get from groundwater to streams and lakes?

To understand how pollutants from septic systems can contaminate surface water, it is important to first understand the ways in which groundwater flows beneath the earth's surface and interacts with surface streams and lakes. Groundwater does not stay in one place, but flows from areas of higher water table elevation towards areas of lower water table elevation. Streams, rivers and lakes are usually low points in a watershed, and shallow groundwater within a watershed flows toward and discharges to these water bodies.

How Groundwater Flows



Groundwater flow paths vary greatly in length, depth, and travel time from points of recharge to points of discharge in the groundwater system.

Figure from U.S. Geological Survey Circular 1139

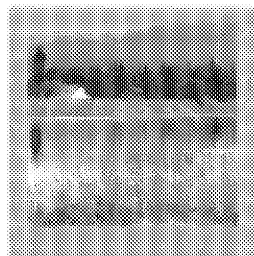
Most of the broad inter-mountain valleys of western Montana, northern Idaho, and northeastern Washington are underlain by aquifers made up of silt, sand, gravel, and cobbles that were deposited by receding glaciers and the streams that flowed from them. These aquifers tend to be shallow, and produce abundant water for domestic, municipal and irrigation water supply wells. The high permeability of many of these aquifers permits relatively rapid infiltration of recharge waters from precipitation, flooding, irrigation, and septic systems. Examples include the Missoula valley aquifer, the Bitterroot valley aquifers, the Spokane River/Rathdrum Prairie aquifer near Couer d'Alene and Spokane, and aquifers in the Flathead valley, Mission Valley, Swan Valley, parts of the upper Blackfoot, and Deer Lodge valleys in Montana, and the Pend Oreille valley in Washington. (Glacial lake sediments, glacial till, and plutonic and volcanic rocks also are important aquifer materials in many areas of the inland Northwest, but are generally much less permeable than the Quaternary alluvial systems described above.)

Groundwater and surface water interact in complex and dynamic ways. The important concept is that surface water and groundwater are not separate, but rather consist of the same water circulating through the hydrologic system. Consequently, any impact to groundwater, such as the discharge from septic systems, will ultimately impact surface water. Managers of septic systems and other sources of groundwater contamination need to recognize that—in many of the geologic settings, such as basin-fill river valleys and lakeshores undergoing intense development pressure—groundwater contamination can have an impact on our surface waters, and vice versa.

Shallow groundwater transport of nitrogen and phosphorus to surface waters:

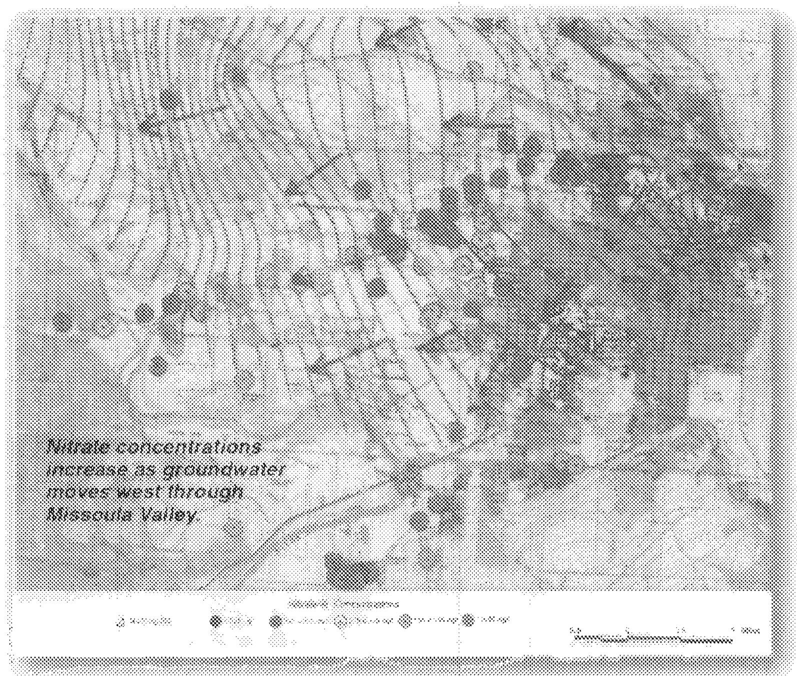
The discussion above shows that septic systems deliver significant loads of nutrients—and particularly nitrogen—to groundwater. Moreover, we know that groundwater in most intermountain valleys of the Northwest generally flows toward surface water and ultimately discharges to streams, river and lakes. Thus, one would expect to find that, in some cases, septic systems are contributing significant amounts of nutrients to surface waters, and causing negative impacts to area waters. This indeed turns out to be the case. Below are examples where such impacts have been documented and linked to the cumulative load from individual septic systems.

- *Missoula Valley, Montana:* Groundwater enters the Missoula valley at its east end, flows west beneath the city and residential areas, and eventually discharges to the Clark Fork and Bitterroot Rivers on the west side of the valley. The east half of the valley is sewered, but the west side of the valley, which is experiencing significant population growth, is on individual septic systems. As groundwater flows from the sewered to the unsewered parts of the valley, nitrate concentrations increase above background levels. In general, nitrate concentrations increase by 0.5 to 2.5 mg/L as groundwater flows under the west valley toward the Bitterroot River (Land and Water, 1999).



Septic systems have the potential to contaminate surface water in geologic settings—alluvial river valleys and lake fronts—where most development is concentrated.

1996 Nitrate-N Concentrations: Unsewered Missosula Area Study



Source: "Evaluation of Unsewered Areas in Missoula, Montana," Missoula Valley Water Water Quality District, et al, March, 1996

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Seeps and springs that discharge directly to the river have nitrate concentrations of 0.8 to 1.3 mg/L, which is significantly higher than normal concentrations in the river of 0.01 to 0.24 mg/L. The estimated flux of nitrate to the Clark Fork and Bitterroot Rivers is 120 tons of nitrate per year, and while the flux is seasonally variable, there are increases in nitrate concentration during summer months in the Bitterroot River as it flows past Missoula (Land and Water, 1999).

- *Rattlesnake Valley, Missoula, Montana:* A similar pattern occurs in Rattlesnake Creek in the Missoula area. Upstream of the developed and unsewered portions of the valley, nitrate concentrations in the stream during baseflow conditions are extremely low (2.5 to 7.6 _g/L, equal to 0.002 to 0.007 mg/L), while below unsewered development, stream nitrate increases 4 to 10 fold above background (Missoula Water Quality District unpublished data). Nitrate concentrations in monitoring wells in the valley are also elevated over background conditions, and contain detectable levels of pharmaceutical chemicals, indicative of a septic system source (Godfrey, 2004).

- *Butte, Montana:* In the Summit Valley area of Butte, Montana, the Montana Bureau of Mines and Geology is investigating the impact of high nitrate in groundwater on surface drainages (LaFave, 2004). Out of about 150 recent and historic groundwater samples from the alluvial and bedrock aquifers, 64% have elevated nitrate concentrations (between 2 and 10 mg/L), and 15% exceed the drinking water standard of 10 mg/L. The nitrate-rich groundwater occurs below both sewered and unsewered parts of town, in both shallow and deep wells, and in areas not likely affected by past mining operations. The impact on local streams is obvious: upstream of populated areas, nitrate in Blacktail Creek is undetectable during base flow conditions (November 2001), but the concentration increases to over 1.0 mg/L over a 5-mile stretch through the most densely populated part of the valley. Analyses of nitrogen and oxygen isotopes in the contaminated groundwater point to an animal or septic waste source for the nitrate rather than fertilizer.

- *Pine Lake, Washington:* Studies of Pine Lake, a small natural lake situated in glacial till in the Puget Sound area of Washington, analyzed the potential for shoreline septic systems to discharge nutrients to the lake (Gilliom, RJ, and CR Patmont, 1983, "Lake Phosphorus Loading from Septic Systems by Seasonally Perched Groundwater," J.Water Poll.Control Fed., Vol. 55:10, p.1297-1305.) The authors concluded that septic effluent was moving through perched groundwater toward the lake, and that 11% of the shallow groundwater from monitoring wells below residences near the lake was actually wastewater effluent. A small amount of phosphorus (less than

Mouth of the Clark Fork River and Lake Pend Oreille, Idaho

1 percent of the septic P load) was shown to be moving in the effluent towards the lake, and in a few cases where older septic systems were situated in saturated soils, a larger portion of the phosphorus was reaching the lake, either through shallow groundwater, or by surfacing of effluent which then passed into the lake as overland flow.

- *Crytal Lake, Michigan:* In a classic study of septic wastewater influence on a clear-water, low-nutrient lake, Kerfoot and Skinner (1981) showed that both nitrogen and small quantities of phosphorus were being discharged into the lake where shallow groundwater was flowing rapidly towards the lake through lakefront developments. Septic effluent entered the lake by: 1) erupting plumes of effluent coming through the near-shore lake-bottom; 2) by "dormant" or passive plumes coming through the lake bottom; and 3) and by surface flow into the lake, at small streams that received septic effluent upstream of the lake.

These authors measured background levels of phosphorus in the lake and unaffected lakeshore groundwater at 0.004 mg/L, while shallow groundwater in septic effluent plumes along the lake was 0.017 mg/L dissolved phosphorus on average. They noted that this increase in concentration in phosphorus, although still low-level, was sufficient to cause impressive blooms of nuisance Cladophora green algae in the near-shore areas around the erupting septic plumes. They concluded that most of the septic effluent phosphorus had been retained by soil treatment, but that the small proportion (slightly less than 1%) which made it to the lake (called phosphorus "breakthrough") was sufficient to cause localized noxious algae blooms, but not sufficient to cause a change in the generalized lake level of phosphorus. They also verified that some coliform bacteria as well as UV light-sensitive detergent compounds were present in the septic discharge plumes entering the lake through shallow groundwater, and that the septic plumes could be easily detected with UV-sensitive equipment.

BACKGROUND NUTRIENT CONCENTRATIONS IN GROUNDWATER

To understand the potential impact of septic systems on shallow groundwater and on surface water, it is important to know the natural condition of the groundwater discharging into streams. Views on this subject have evolved in recent years.

Although earlier studies from the U.S.Geological Survey (USGS) defined concentrations of nitrate in groundwater exceeding 2 mg/L or even exceeding 3 mg/L as the levels indicating human impact on aquifer water quality (Madison and Burnett, 1985, Mueller et.al., 1995), newer studies have shown that natural nitrate concentrations are generally far lower.

In 2003, new USGS studies based on the National Water Quality Assessment (NAWQA) program for the continental U.S. concluded that, "Mean concentrations of nitrate in NAWQA land use studies showed 2.8 mg/L in agricultural areas, 1.45 mg/L in urban areas, and 0.06 mg/L in undeveloped areas." (Nolan and Hitte, 2003.) In relatively undeveloped areas, the median groundwater nitrate levels were 0.1 mg/L. These values are similar to data from similar land uses in Montana, Idaho, and Washington.

From the perspective of surface water contamination, the elevation of nitrate in alluvial groundwater to even the 1-3 mg/L level typical of urban and agricultural land uses, can be significant if groundwater is a major contributor to surface water flows. This is because typical levels of nitrate in natural streams, rivers, and lakes of the inland Northwest/Northern Rockies are 5 - 10 times lower than that level. (EPA, 2000, "Ambient Water Quality Criteria Recommendations-Information Supporting the Development of State and Tribal Nutrient Criteria for Rivers and Streams in Nutrient Ecoregion II, EPA Office of Water, Office of Science and Technology, Washington, DC; Clark Fork VNRP, Tri-State Water Quality Council, 1998). Therefore, nutrient-sensitive surface waters can experience significant excess nutrient loading from groundwater typical of agricultural or urban landscapes.

Mitigation of Nutrient Discharge from Septics to Surface Waters:

The previous sections discussed how significant quantities of nutrients from septic tanks can reach groundwater, and how that contaminated groundwater can reach streams and lakes and contribute to harmful nutrient enrichment. However, not all of the nutrients that reach groundwater necessarily make it to surface water. As we have seen, most or all phosphorous from septic systems usually sorbs onto soil particles long before reaching a stream or lake. Moreover, there are two processes that can eliminate at least some of the nitrogen from groundwater: plant uptake and denitrification. These two processes can reduce, but not always eliminate, impacts to surface water.

Plants will uptake nitrate from groundwater if their roots reach the water table. Plants incorporate nitrate into their tissues, where it remains until it is released back to the soil when plants die and decay. Thus, vegetation does not remove nitrogen from the ecosystem, but temporarily decreases its mobility. Nutrient uptake by vegetation occurs only during parts of the year when plants are growing; this precludes about half the year in western Montana.

Apart from uptake by plants, denitrification is the only other natural process that potentially removes nitrate from groundwater. Denitrification is a microbially mediated reaction in which nitrate in groundwater is reduced to nitrogen gas which diffuses to the atmosphere, effectively removing nitrogen from the terrestrial environment. The denitrification reaction requires a low-oxygen environment and a source of energy for the microbes. Typically the energy source is the dissolved organic carbon found in fertile, organic soils, but denitrification can also occur in the presence of ferrous iron, sulfide, or methane (Postma et al., 1991; Korom, 1992; Böhlke and Denver, 1995; Star and Gillham, 1993; Böhlke et al., 2002). Consequently, denitrification is most likely to occur in water-logged soils, in shallow groundwater overlain by rich organic soil, in organic-rich riparian areas where groundwater is close to the surface, and in aquifers containing trace amounts of iron sulfide (pyrite). Denitrification can occur anywhere in an aquifer if conditions are right: up-gradient from streams, in riparian areas, in the zone of groundwater-stream mixing, and in the benthic environment of the stream itself (Böttcher et al., 1990; Smith et al., 1991; Postma et al, 1991; Vogel et al., 1981).

Denitrification also requires a flow regime that brings groundwater into contact with reactive substrates for a sufficient amount of time to allow the reaction to occur. For example, shallow groundwater that discharges rapidly to a stream, or deep groundwater that discharges vertically to the stream bottom is less likely to undergo denitrification (Böhlke and Denver, 1995). Likewise, groundwater flow that discharges to ditches or drains will bypass the riparian zone and is less likely to be denitrified (Puckett, 2004). Denitrification is also less likely to occur where groundwater moves rapidly through coarse, gravelly, alluvial material (Pinay et al., 2003). A review of numerous studies of groundwater in riparian areas shows highly varying efficiencies of nitrate removal from groundwater, ranging from 0% to over 90% (Peterjohn and Correll, 1984; Lowrance et al., 1984; Jacobs and Gilliam, 1985; Lowrance, 1992; Korom, 1992; Puckett, 2004). As a mechanism of nitrate removal, denitrification may be very important in some areas, and completely negligible in others.

Regional examples demonstrate the conditions under which denitrification occurs. In the Upper Snake River basin of Idaho and western

Wyoming, areas with rapidly drained soils correlate with high-nitrate groundwater while areas with poorly drained soils contain groundwater with the lowest nitrate concentrations (Rupert, 1997). Out of 61 groundwater samples collected from wells in western Montana, northern Idaho, and eastern Washington, the USGS found no correlation between nitrate concentration and well depth or depth of the water table, but there was a strong correlation with dissolved oxygen; groundwater with undetectable nitrate also had very low dissolved oxygen concentrations, possibly indicating that denitrification was removing nitrate from groundwater (Caldwell et al, 2004).

In the Missoula valley, soil and groundwater sampling immediately beneath and down-gradient from septic systems demonstrates different mechanisms of nitrate dilution and potential attenuation in the aquifer. In the Orchard Homes area, nitrate was not removed in the soils below two separate drain fields, but dilution in groundwater was responsible for reducing nitrate to background concentrations (Ver Hey, 1987). Subsequent studies indicate that nitrate may be attenuated by factors other than dilution. By comparing ratios of nitrate to the non-reactive chloride ion, King (1987) found that nitrate decreased faster than chloride with increasing distance from drain fields, up to a threshold value, at which point the ratios remained constant. The reduction of nitrate concentrations in the aquifer could result from denitrification, or possibly from uptake by native bacteria in the aquifer.

Clark Fork River flowing west through Missoula, Montana

WASTEWATER TREATMENT:
What are the options when trying to achieve public health and resource protection goals?

Every community must find ways to treat its wastewater to levels that protect public health and water quality in streams, lakes, and aquifers. Communities in rural areas can often meet these goals using conventional septic systems, thanks to low population density and large lot sizes. Larger communities are often able to meet the same goals using centralized sewage treatment plants, thanks to their larger capital base. Caught in the middle are fast-growing suburban and semi-rural areas, which present the most difficult challenges for effective wastewater management. These communities often cannot use centralized sewer systems due to limitations on available capital. At the same time, the resources these communities must protect are often particularly sensitive to impacts, since residents typically rely on individual wells for drinking water, and residential development in the Northwest often occurs near rivers and streams that are sensitive to nutrient enrichment.

When a community must choose among various systems for treating its wastewater – on-site septic systems, centralized sewage plants with sewers, or smaller-scale collective treatment systems serving individual subdivisions – it should carefully weigh the inherent strengths and weaknesses of each. Each type of system poses risks to public health and aquatic environments, and must be managed with the various types of risks in mind.

Centralized systems offer several distinct advantages: they can provide the most nitrogen removal if they are fitted with biological nutrient removal (BNR) or other advanced treatment systems. Moreover, they centralize an entire community's discharge in one place where it can be easily monitored, where any problems can be readily detected, and where treatment upgrades can be installed with relative ease if found to be necessary in the future. On the other hand, centralized systems generally do not provide the same level of phosphorous treatment as on-site systems, at least when they discharge directly into a river and therefore do not get the benefit of treatment in the soil. Centralized systems can sometimes overcome this disadvantage by discharging to constructed wetlands or land-applying effluent to agricultural fields, but these solutions present additional design and operational challenges.

On-site septic systems treat phosphorous well. Although they remove very little nitrogen, advanced septic designs are now available that can provide levels of nitrogen removal comparable to BNR at centralized systems, if they are maintained and operated properly. But ensuring proper maintenance and operation of these systems is a challenge. Their nutrient removal components can fail without showing any trouble signs to alert the homeowner to the failure. Moreover, these systems effectively disperse wastewater treatment at hundreds or thousands of individual home sites, rendering effective monitoring, inspection, and enforcement virtually impossible. In addition, advanced systems are expensive.

Collective treatment systems – in which wastewater at the subdivision level (from several dozen to a few hundred homes (??)) is routed to a single on-site system – offer some of the advantages of both centralized and individual systems. Like individual systems, they allow for ample treatment of phosphorous in the soil before effluent reaches surface water. And like centralized systems, they route individual waste streams to a central point where monitoring, maintenance, and upgrades in treatment are much more feasible. In addition, collective treatment systems generally are required to obtain groundwater discharge permits, which provide a way of ensuring that the systems are being properly monitored and maintained so that treatment is meeting design standards.

Comparison of Alternative Wastewater Treatment Systems in Nutrient Removal:

Table 3 below shows the nitrogen and phosphorous concentrations in wastewater effluent from different sources. It also illustrates the dangers of directly comparing effluent concentrations from different types of systems without considering the additional treatment provided in soil between the discharge and surface water.

Table 3: Comparison of Nutrient Loads Discharged from Various Types of Wastewater Treatment

Wastewater Treatment Technology (examples)	Total Nitrogen	Total Phosphorus
1. Lolo Conventional Secondary Wastewater Treatment 2. Missoula WWTP in 1992 – Secondary Treatment	22.0 mg/l 21.9 mg/l	3.8 mg/l 3.5 mg/l
3. Kalispell Biological Nutrient Removal WWTP - 2001 4. Missoula Biological Nutrient Removal (Design Goals)	9.4 mg/l 10.0 mg/l	0.11 mg/l 1.0 mg/l
5. Conventional on-site septic tank (EPA 2002)	40 - 100 mg/l	5 - 15 mg/l
6. Estimated Removal by Drainfield Soil Treatment (conventional septic system): (EPA, 2002, Table 3.17)** 7. Estimated Remaining Nutrients Discharged to Ground Water (based on #6 above) :	10 - 40% 30 - 45mg/ l	85 - 95% 0.5 - 1.6 mg/l
8. Montana Level 2 Nitrogen Removal Systems*	24 mg/l	10.6 mg/l (0.5 - 1.6 mg/l after soil treatment)

*Only three approved Level 2 systems exist for Montana
**Montana assumes residences discharge 50 mg/L nitrate to groundwater

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REDUCING THE IMPACTS:

What are the existing policy and regulatory options for mitigating the impacts to surface waters?

As described in preceding sections of this paper, there is now a good deal of data establishing that septic tanks can, and often do, have significant effects on the water quality of streams and lakes, especially in regards to nutrients. To date, however, the potential for septic systems to degrade surface water quality has gone largely unrecognized in the federal, state, and local laws that are designed to protect surface water quality. As a result, many thousands of septic tanks are being permitted and installed in the Northwest each year with little or no analysis of their cumulative impacts on surface lakes and streams.

The following section describes the existing regulatory scheme that one state, Montana, uses for permitting septic tanks and other private sewage treatment systems. This discussion will focus on the ways in which that permitting scheme addresses—and fails to address—potential impacts to surface water. Montana was chosen as an example not only because it is most familiar to the authors of this paper, but also because it appears to have done more than any other state in the region to address surface water impacts from private wastewater systems. The Montana example then serves as the basis for a discussion of different alternatives for expanding existing laws and policies in ways that would recognize and mitigate these impacts.

Prescriptive versus performance-based approaches to wastewater management:

The various Montana laws governing wastewater systems use one of two general approaches to regulate impacts. The prescriptive approach focuses on the source of pollutants—the septic system itself—and sets forth minimum requirements for septic system design, siting and installation. An example of such requirements would be minimum setback distances from drinking water wells, surface water, and groundwater. In contrast, the performance-based approach focuses on the waters potentially at risk from pollution. This approach identifies the lakes, streams, or aquifers at risk, then attempts to calculate whether the these waters can assimilate the pollutant load from the wastewater system or systems in question without degrading water below acceptable levels (usually defined by ambient water quality standards). If not, the design approach requires alternatives such as advanced treatment, different siting, or not allowing the system to be installed at all. (EPA 2002).

At present, Montana regulates septic systems primarily by the design approach. Although Montana does not generally apply the design approach to prevent septic system impacts to surface waters, it does have the legal framework in place to impose such controls if it were deemed necessary to do so.

Prescriptive-based laws and regulations:

- *State and local septic system regulations:* As mandated by statute, the Montana Department of Environmental Quality (MDEQ) has enacted minimum standards for the design, installation, and maintenance of conventional septic systems. These regulations generally ensure the systems will provide the level of treatment described in Chapter 3 of this paper – i.e., removal of most pathogens and the nutrient phosphorous. Recently, MDEQ enacted a set of minimum standards for advanced septic systems that can remove significant levels of nitrogen as well. These systems, designated Level II systems, are available for use when conventional systems are unable to meet minimum water quality standards required by performance-based laws discussed in section 6.3, below.

State law requires local boards of health to enact and enforce septic system regulations that are at least as stringent as the MDEQ standards discussed above.[1] Local boards may also, under certain conditions, enact septic regulations that go beyond state standards. These may be used to restrict or prohibit septic systems in certain areas due to local conditions. For example, the Missoula City-County Health Board has established three separate districts where septic systems are discouraged or prohibited. In one case the district was established because an area has high existing groundwater nitrate concentrations, and in another case because the area has high groundwater elevations. The third district comprises the entire service area of the Missoula municipal wastewater treatment plant, where the policy is to encourage new development to connect to the sewer system as soon as it is practical to do so.

- *State subdivision regulations:* Montana's subdivision laws contain density limitations or minimum lot area requirements for septic systems, which are primarily intended to mitigate impacts to human health. These regulations require a minimum lot size of one acre for each on-site wastewater system and well in a proposed subdivision. If a community water supply or wastewater system will serve the subdivision, the minimum lot size is decreased to 20,000 square feet. If both a community water supply and a community wastewater system are provided, lot sizes can be smaller (Montana ARM 17.36.340). The intent of these regulations is to protect human health by providing adequate buffers between septic systems and drinking water wells to allow adequate treatment of pathogens and other harmful substances. However, these regulations may provide incidental benefits to surface waters to the extent they limit the total number of homes that can be built in an area, thereby limiting the total nutrient load.

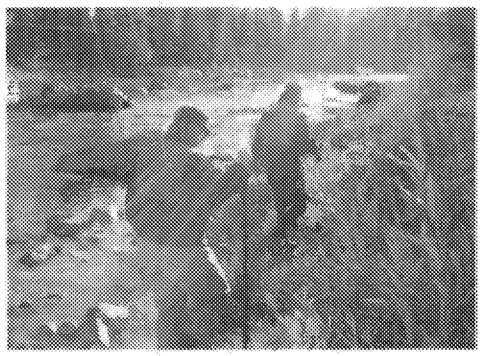
Regulatory systems designed to protect groundwater will NOT protect surface water adequately.

Performance-based laws and regulations:

- *Nondegradation policy:* The primary performance-based Montana law protecting surface water quality is the state nondegradation policy, codified at MCA 75-5-303, which implements the substantive requirements of the federal Clean Water Act.[2] The nondegradation policy makes it illegal to engage in any activity that will cause significant degradation of high-quality waters, which include the vast majority of natural surface waters in the state.[3] Both the statute and related administrative rules contain extensive provisions describing activities that, by definition, are not legally significant degradation.[4]

In order to obtain a permit for a septic or other private wastewater system, one must establish that any deterioration in water quality caused by the system will fit within one of the recognized definitions of nonsignificant degradation. Since most systems are permitted in the context of proposed subdivisions of land, this nondegradation analysis is usually done by the developer as a condition of receiving final

Blackfoot River, Montana



[1] MCA § 50-2-116(1)(b)(i).

[2] *See* 40 CFR § 131.12.

[3] *See* MCA §§ 75-5-303(2), -301(5)(c).

[4] *See* MCA §§ 75-5-301(5)(c), -301(5)(d), and -317; ARM §§ 17.30.715 and -716.

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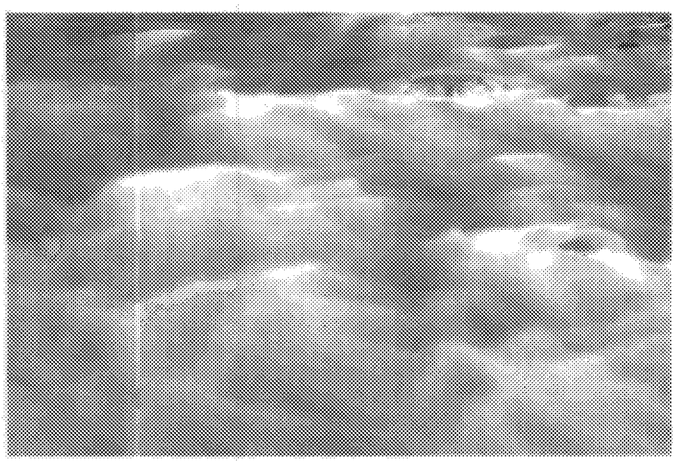
approval for the subdivision from the local government authority.[5] The developer does this by submitting site-specific sampling data and analysis, which is reviewed by specialists at the state Department of Environmental Quality (MDEQ) or, in some cases, by local specialists certified by MDEQ.[6] In the case of sewage systems, the analysis focuses on nitrogen and phosphorous, the two relevant pollutants for which the state has adopted water quality standards.[7]

The nondegradation rules provide several ways to establish that a discharge of nitrogen and phosphorous will not significantly degrade surface water. In the case of nitrogen, most domestic sewage systems are not required to undergo any surface water nondegradation analysis at all. The only exceptions are those systems that are close enough to a lake or stream to be considered "adjacent" to surface water, a determination that MDEQ makes on a case-by-case basis. In these cases, the permitee must submit site-specific data and modeling to establish either (1) that the discharge will not cause the surface water concentration of nitrogen to increase by more than the trigger value for nitrogen (.01ppm), or (2) that the discharge will not violate the narrative standard prohibiting any "measurable changes in aquatic life or ecological integrity."[8]



In the case of phosphorous, the vast majority of discharges are found to be nonsignificant by the submission of a "phosphorous breakthrough analysis" that analyzes the adsorption capacity of the local soil. A discharge is considered not to cause a significant degradation of surface water if the breakthrough analysis shows that no phosphorous from the system will reach surface water for at least 50 years.[9] In the rare cases where a site fails to pass the breakthrough analysis, the permitee can establish that the discharge is nonsignificant using the trigger value approach described above (except that the trigger value for phosphorous is .001 ppm), or by showing the discharge will not have a measurable impact on aquatic life or ecological integrity.[10]

A weakness of the trigger value and narrative standard approaches is that they do not consider cumulative impacts. That is, the question in each case is whether the individual development being reviewed will cause the trigger value or narrative standard to be exceeded, without regard to the impacts of existing or future development.[11] As a practical matter, the discharge from a single small subdivision, much less a single septic system, is seldom if ever sufficient to cause a .01 mg/l increase in nitrogen in a river or lake, especially considering that compliance is not measured where the discharge to surface water occurs, but rather at the end of a potentially lengthy mixing zone. As a result, the trigger value approach has had little or no effect on the permitting of domestic wastewater systems, even in areas of the Clark Fork and lower Bitterroot

5 *See* MCA §§ 76-3-504(1)(f)(3) and -76-3-604.

6 The permitee need not submit a site-specific nondegradation analysis if site-specific data show that the site qualifies for one of the categorical exemptions spelled out in the rule. These exemptions are based on considerations such as soil type, depth to groundwater, and distance to surface water. *See* ARM 17.30.716(2).

7 *See generally*, "How to Perform a Nondegradation Analysis for Subsurface Wastewater Treatment Systems," MDEQ handbook, March 2005.

8 This section of the rule applies where only narrative standards for nutrients exist. On the Clark Fork River between Warm Springs Ponds and the Flathead River, where numeric standards for nitrogen and phosphorous has been adopted, the permitee would have to show that the predicted in-stream concentration after the discharge is mixed in-stream was less than 15% of the numeric standard in order for the discharge to be considered nonsignificant.

9 ARM § 17.30.715(1)(e).

10 ARM §§ 17.30.715(1)(c) and -715(1)(g). Trigger values are found in DEQ Circular WQB-7 (numeric water quality standards).

11 *See* "How to Perform a Nondegradation Analysis," p. 45. However, multiple phases of a single development proposal are considered to be a single development and are reviewed together for trigger value compliance. Id.

valleys where data suggest that the cumulative load from these systems far exceeds the trigger value, and is likely a significant contributor to algae growth as well.

In addition to the above provisions related to surface water, Montana's nondegradation rules contain other, far more extensive provisions regulating the concentration of nitrogen in groundwater.[12] These groundwater regulations are driven primarily by the need to keep levels of nitrogen from approaching the 10 mg/l human health standard for groundwater. In actual practice, compliance with groundwater standards—which is highly dependent on local factors such as, lot sizes, alignment of drainfields, and dispersion rates—dominates the nondegradation analysis for most proposed subdivisions.Surface water concerns play only a minor role.

- *Surface water discharge permit regulations:* Montana regulates point-source discharges to surface water under the Montana Point Source Discharge Elimination System, or MPDES program. All wastewater systems, including septic tanks, technically qualify as point sources under the MPDES regulations, which define that term as "any discernible, confined, or discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, [or] conduit . . . from which pollutants are or may be discharged."[13] Despite this, however, MDEQ does not require privately-owned sewage systems to obtain MPDES permits, even when they discharge pollutants to surface water via hydrologically-connected groundwater. The legal reason for this is not clear.[14] MDEQ does require point-source discharges to hydrologically-connected groundwater in other contexts, such as mining, to obtain MPDES permits. Therefore, MDEQ does have the legal authority to regulate septic systems that have the potential to discharge nutrients to surface water under the MPDES program, should MDEQ choose to exercise that authority.

There are several potential ways the MPDES system could fit into an overall scheme to control cumulative nutrient impacts from septic tanks and other sewage systems. For example, while it would obviously be unmanageable to require every septic tank that discharges to alluvial aquifers in a river basin to get an MPDES permit, the state could prepare a general permit setting forth specific requirements for geographical areas within basins where nutrients are known to be a problem. Such requirements could include the use of level II treatment systems where appropriate. In the case of collective systems, it might be desirable to require individual MPDES permits, not only to require advanced nutrient treatment, but also as a way to implement monitoring requirements to insure that nutrient removal is functioning effectively and to provide information about the load these sources are contributing to surface water. Such information could help to equitably allocate cumulative loads among various dischargers, as discussed in more detail below.

- *Groundwater discharge permit regulations:* Montana regulates discharges of pollutants to groundwater under the Montana Groundwater Pollution Control System (the MGWPCS program). Due to a series of statutory and regulatory exclusions, privately-owned sewage systems are not required to obtain MGWPCS permits unless they have a design capacity of greater than 5,000 gallons per day (equivalent to about 25

[12] See ARM §§ 17.30.715(1)(d) and -716(2); see generally "How to Perform a Nondegradation Analysis."

[13] ARM § 17.30.1304(41).

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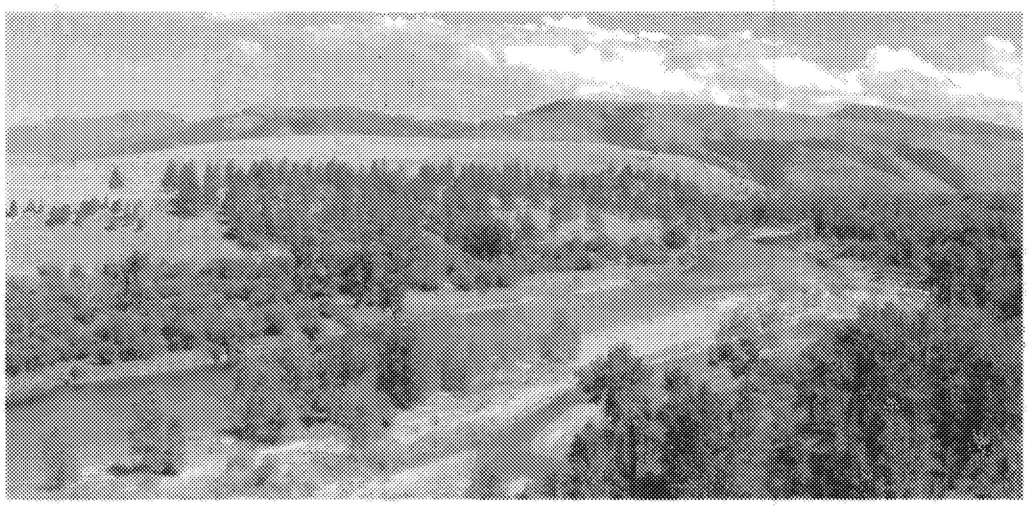
residences).[14] In many cases, these exemptions allow developments to avoid being regulated by the MGWPCS system by installing two or more smaller-capacity collective systems instead of a single large system, or by installing individual septic tanks. As noted in Chapter 5, centralized, permitted systems offer several advantages over individualized systems because they route sewage to a single collection point and treatment system, greatly simplifying the tasks of monitoring, maintenance, and inspection. In addition, the effluent limits and ambient monitoring requirements imposed by MGWPCS permits could provide important information that could be used for equitable load allocation.[15]

- *Total Maximum Daily Load provisions:* The Montana Water Quality Act contains a process for reducing pollutants such as nitrogen and phosphorous to allowable levels in a stream or lake where they currently fail to meet water quality standards. This process, which is set forth in the federal Clean Water Act, is known as the Total Maximum Daily Load, or TMDL program.[16] The basic concept behind the TMDL process is relatively simple. In basic terms, the process consists of determining the total load of a pollutant that can be discharged into a waterbody while still meeting standards, allocating equitable portions of that load to each of the identified sources of that pollutant, and then implementing controls on each source to ensure it does not exceed its allowable load.[17]

In reality, the process of developing a TMDL is very complex to say the least. In practical terms, the process is complicated by variables such as flow rates, discharge rates, and in-stream attenuation, each of which can be highly variable across time and space. In legal terms, the process is complicated by the fact that regulators may impose mandatory restrictions only on point sources, while all controls on non-point sources are voluntary. Therefore, if there is a general increase in loading from non-point sources over time, point sources tend to suffer, since they are the only sources on which regulators can impose mandatory restrictions to meet standards.

Despite the complications, Montana has developed a TMDL for nitrogen and phosphorous in one 200-mile long reach of river, the Clark Fork River between Warm Springs Ponds and the Flathead River confluence. This TMDL is based on a computer model that considers the discharges from the four largest point sources on this reach (three municipalities and one paper mill), an estimated cumulative discharge

Bitterroot River, Montana



[14] *See* MCA § 75-5-401(5)(b); ARM § 17.30.1022(c) through (f).

[15] *See* ARM § 17.30.1031(5).

[16] *See* 33 U.S.C. § 1313(d)(1)(C); 40 CFR § 130.7; MCA § 75-5-03.

[17] *See* 40 CFR §§ 130.7(c) and 130.2.

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from over 6,000 septic systems in the Missoula valley, the inputs from each major tributary, and a calculated allowance for the total non-point discharge for each designated sub-reach of river. Measures were then developed to reduce the discharge from each of the four major point sources, and one concentrated group of septic systems in Missoula, and, using the model, a prediction was made that if the point sources implemented these measures the river would comply with numeric standards for nitrogen and phosphorous. These numeric standards were developed for this particular reach of river based on many years of monitoring data for both nutrients and algae.

A weakness of the Clark Fork River TMDL is that it does not allocate nitrogen and phosphorous loads to point sources other than the four major dischargers. Although plans exist to bring smaller point-sources that discharge directly to surface water into the TMDL in the next few years as their MPDES permits are renewed, there currently are no plans to allocate loads to sources such as sewage systems that discharge nutrients to surface water indirectly via hydrologically-connected groundwater. Instead, the TMDL treats these discharges as non-point source pollution. Therefore, the TMDL presently contains no mechanism to prevent the increasing load from septic tanks and privately-owned collective sewage treatment systems from "eating into" the load that is presently allocated to point sources that discharge to surface water directly.

It is possible to assign load allocations to groundwater dischargers in a surface water TMDL. Collective sewage systems with capacities greater than 5,000 gpd already have MGWPCS permits, with calculated limits on the maximum load they may discharge to groundwater. Where adequate aquifer data exist, rough estimates could be made of the amount of their load that reaches surface water, and this load could be incorporated into the TMDL. Where systems discharge in close proximity to the river, it might make sense to conservatively estimate that 100% of the load goes directly to surface water, while in the case of more-distant dischargers, some fraction of the load might be more appropriate. Although smaller systems such as septic tanks would provide a greater challenge due to their sheer numbers, estimates of their surface water load could still be made in many cases. Local governments have data on the location of most if not all septic permits within their jurisdictions, and standard assumptions could be used regarding the average daily load generated by a residential septic system. Although the surface water loading calculations for all groundwater dischargers would necessarily be inexact, they might represent a significant improvement over the alternative of simply ignoring these point sources in a nutrient TMDL.

Discussion of policy alternatives:

It is clear that the existing legal framework in Montana already provides the tools that could be used in concert to mitigate and prevent surface water quality impacts from septic systems. These tools include both prescriptive and performance-based approaches. Montana's water quality-based standards and non-degradation policy could be used to identify waters that are impaired or at risk from excessive nutrients. The non-degradation policy could be used—provided some way were developed to account for cumulative impacts—to identify development projects that threaten to cause unacceptable degrees of degradation. Point-source regulations and design standards could then be used in conjunction with land use regulations to control the size of cumulative nutrient loads, both by requiring higher levels of treatment and limiting the number of systems allowed in a given area. The TMDL system could provide a way of allocating cumulative nutrient loads between different areas, and between point and non-point sources. Finally, local governments could identify areas within their boundaries that are particularly sensitive to nutrient impacts—as Missoula County has already done—and apply higher levels of protection to those areas by requiring advanced treatment, collective on-site systems, or connection to a municipal sewer system.

CONCLUSIONS

- Rapid development of valleys and property near streams and lakes in rural counties of the inland Northwest highlights the potential for septic systems to contaminate surface waters—a different issue than the typical human health focus of septic system regulation.

- Septic system effluent is discharged to shallow groundwater, which moves along flow lines and eventually carries soluble constituents like nitrate nitrogen toward surface water.

- Other constituents of septic effluent, such as phosphorus, pathogenic organisms, and some household products, are mostly removed during the soil treatment process, but have also been detected in groundwater near septic systems.

- Shallow groundwater affected by septic effluent discharges into streams, rivers, and lakes in many geologic settings. Alluvial basin-fill valleys and lakeshore areas where shallow groundwater flows towards waterfront are prime areas for septic nutrients—especially nitrates, but sometimes small quantities of phosphorus—to be discharged through the groundwater into surface water.

- As nutrients from septic effluent are transported in ground water, partial mitigation by chemical denitrification or biological uptake may occur, but is not assured.

- Levels of nitrate nitrogen in shallow groundwater under developing areas are often far higher than background concentrations, and far higher than their concentrations in healthy surface waters. Phosphorus concentrations in groundwater, even when low, are often higher than levels in clean streams and lakes. This means that shallow groundwater flowing into streams, rivers and lakes from developed areas is expected to increase nutrients, especially nitrates, in these surface waters.

- In settings where septic-contaminated groundwater inflow makes up a significant portion of surface water flows, surface water nutrient loading from septic effluent will occur, and can be a significant portion of total nutrient loads to sensitive waters.

- In lake-front settings, septic systems have been documented to discharge not only nitrogen but also phosphorus to the lakes via a shallow groundwater aquifer, causing near-shore noxious algae blooms.

- In general, septic systems are an important source of nutrients, especially nitrates, to groundwater and surface water in rural areas experiencing rapid growth. New septic systems inexorably add nitrates to the cumulative nutrient loads in surface waters. Other factors common to land development (e.g. construction sediments, road runoff, fertilizers, industrial projects) also typically increase phosphorus loading to surface waters. This combination of nitrate and phosphorus loading is highly detrimental to fresh water lakes and streams.

- Technical options for reducing the septic nutrient load to surface waters include various alternative septic systems, but management of septic system impact will require attention to cumulative effects at a watershed level, not just technical options.

- In some cases, using new nutrient-reduction septic systems actually encourages further development in sensitive watershed areas that would not have been built out with traditional septic systems. For nutrient-sensitive surface waters, this could result in a net loss of water quality.

- Subdivision-scale collective treatment systems may offer the best way to control wastewater nutrients in suburban and semi-rural settings, combining some advantages of both centralized sewers and individual septic systems.

- Some states address the possibility of phosphorus "breakthrough" into surface waters from older septic systems. Other states ignore this possibility.

- Some states currently require analysis of septic nutrient loading to surface waters, including phosphorus "breakthrough" as septic systems age. Other states do not address this issue.

- It is unclear to what extent TMDL implementation will address the cumulative nutrient load issues of septic systems in rapidly growing rural areas.

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Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

EXHIBIT 8

Public Water Supply Systems

Help Report

Name:	DAIRY DREAMS LLC	**DNR Public Water Supply ID:**	43100398
Type:	Non-transient, non-community	**Status:**	Active
DNR Region:	Northeast Region	**County:**	Kewaunee
Address:	E3576 CARDINAL RD	**City:**	CASCO
Zip Code:	54205	**Population:**	30
Transient Population:		**% Surface Water:**	
% Ground Water:	100	**% Purchased Ground Water:**	
% Purchased Surface Water:		**Service Connects:**	
Water Meters:		**Storage Capacity:**	
Service Types:	Other non-community service	**Most Recent Sanitary Survey:**	01/04/2011
Season Begins:		**Season Ends:**	
Provides water to another system:	No	**Receives water from another system:**	No

Contacts

Name	Type	End Date	Phone	E-Mail
WITCPALEK, STEVE M	CERT OPERATOR	certification: 11/01/2016	Not available	Not available
HANAWAY, MIKE	DNR_REP		920-755-4987	michael.hanaway@wi.gov
DENIL, JOE	EMERGENCY		Not available	Not available
NILES, DON - OWNER	OWNER		Not available	Not available
WITCPALEK, STEVE M - MAINT MGR	SAMPLER		Not available	Not available

Records 1 to 5 of 5

Active Dates

Start	End
02/14/2011	

Record 1 of 1

- Inspections (2 Rows)

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Other (non-bacteriological) Samples

Help Reports

PWS ID 43100398 DAIRY DREAMS LLC

Sample Group:	Inorganics
Source ID:	200
Well #:	(none)
Sample ID:	831188
Sample Date:	11/10/2014
Sample Time (24-hour clock):	1100
Type:	Compliance
Reported Date:	11/19/2014
Reason:	SDWA
Source:	Entry Point
# Samples:	1
Collector:	S WITCPALEK
Lab Id:	721026460
Lab Name:	Northern Lake Service Inc. (Crandon)

Sampling Results

Code	Description	Result	Units	Qualifier	Limit of Detection	Limit of Quantification	MCL	MCL Units
1040	NITRATE (N03-N)	8	MG/L		0.13	0.38	10	MG/L

Record 1 of 1

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Last Revised: 02/17/2015

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Public Water Supply Systems

Help Report

Name:	KINNARD FARMS INC	**DNR Public Water Supply ID:**	43101443
Type:	Non-transient, non-community	**Status:**	Active
DNR Region:	Northeast Region	**County:**	Kewaunee
Address:	E2675 COUNTY RD S	**City:**	CASCO
Zip Code:	54205	**Population:**	32
Transient Population:		**% Surface Water:**	
% Ground Water:	100	**% Purchased Ground Water:**	
% Purchased Surface Water:		**Service Connects:**	
Water Meters:		**Storage Capacity:**	
Service Types:	Other non-community service	**Most Recent Sanitary Survey:**	03/22/2011
Season Begins:		**Season Ends:**	
Provides water to another system:	No	**Receives water from another system:**	No

Contacts

Name	Type	End Date	Phone	E-Mail
EUCLIDE, MARK E	CERT OPERATOR	certification: 01/01/2016	Not available	Not available
HANAWAY, MIKE	DNR_REP		920-755-4987	michael.hanaway@wi.gov
KINNARD, ROD	EMERGENCY		Not available	Not available
KINNARD, LEE - OWNER	OWNER		Not available	Not available
EUCLIDE, MARK - SAMPLER	SAMPLER		Not available	Not available

Records 1 to 5 of 5

Active Dates

Start	End
07/01/2011	

Record 1 of 1

- Inspections (2 Rows)

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Other (non-bacteriological) Samples

Help Reports

PWS ID 43101443 KINNARD FARMS INC

Sample Group:	Nitrate
Source ID:	100
Well #:	(none)
Sample ID:	360929
Sample Date:	02/26/2014
Sample Time (24-hour clock):	1208
Type:	Compliance
Reported Date:	02/28/2014
Reason:	SDWA
Source:	Entry Point
# Samples:	1
Collector:	M EUCLIDE
Lab Id:	445126660
Lab Name:	Clean Water Testing LLC
Lab Comments:	ICED

Sampling Results

Code	Description	Result	Units	Qualifier	Limit of Detection	Limit of Quantification	MCL	MCL Units
1040	NITRATE (N03-N)	1.01	MG/L		.1	.31	10	MG/L

Record 1 of 1

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Last Revised: 02/17/2015

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Public Water Supply Systems

Help Report

Name:	PAGELS PONDEROSA DAIRY	**DNR Public Water Supply ID:**	43100134
Type:	Non-transient, non-community	**Status:**	Active
DNR Region:	Northeast Region	**County:**	Kewaunee
Address:	N4893 COUNTY RD C	**City:**	KEWAUNEE
Zip Code:	54216	**Population:**	25
Transient Population:		**% Surface Water:**	
% Ground Water:	100	**% Purchased Ground Water:**	
% Purchased Surface Water:		**Service Connects:**	
Water Meters:		**Storage Capacity:**	
Service Types:	Other non-community service	**Most Recent Sanitary Survey:**	10/13/2010
Season Begins:		**Season Ends:**	
Provides water to another system:	No	**Receives water from another system:**	No

Contacts

Name	Type	End Date	Phone	E-Mail
WITCPALEK, STEVE M	CERT OPERATOR	certification: 11/01/2016	Not available	Not available
HANAWAY, MIKE	DNR_REP		920-755-4987	michael.hanaway@wi.gov
WITCPALEK, STEVE M - MAINT MGR	EMERGENCY		Not available	Not available
PAGEL, JOHN T - OWNER	OWNER		Not available	Not available
WITCPALEK, STEVE M - MAINT MGR	SAMPLER		Not available	Not available

Records 1 to 5 of 5

Active Dates

Start	End
01/01/2011	

Record 1 of 1

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Other (non-bacteriological) Samples

Help Reports

PWS ID 43100134 PAGELS PONDEROSA DAIRY

Sample Group:	Nitrate
Source ID:	200
Well #:	(none)
Sample ID:	774815
Sample Date:	03/13/2014
Sample Time (24-hour clock):	945
Type:	Compliance
Reported Date:	03/24/2014
Reason:	SDWA
Source:	Entry Point
# Samples:	1
Collector:	S WITCPALEK
Lab Id:	721026460
Lab Name:	Northern Lake Service Inc. (Crandon)

Sampling Results

Code	Description	Result	Units	Qualifier	Limit of Detection	Limit of Quantification	MCL	MCL Units
1040	NITRATE (N03-N)	.066	MG/L	Between LOD and LOQ	.025	.075	10	MG/L

Record 1 of 1

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Last Revised: 02/17/2015

93D CONGRESS } HOUSE OF REPRESENTATIVES { REPORT
2d Session } { No. 93–1185

EXHIBIT 9

SAFE DRINKING WATER ACT

JULY 10, 1974.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. STAGGERS, from the Committee on Interstate and Foreign Commerce, submitted the following

REPORT

[To accompany H.R. 13002]

The Committee on Interstate and Foreign Commerce, to whom was referred the bill (H.R. 13002) to amend the Public Health Service Act to assure that the public is provided with safe drinking water, having considered the same, report favorably thereon with one amendment and recommend that the bill as amended do pass.

The amendment strikes out all after the enacting clause and inserts a new text which appears in italic type in the reported bill.

PURPOSE OF LEGISLATION

The purpose of the legislation is to assure that water supply systems serving the public meet minimum national standards for protection of public health. At present, the Environmental Protection Agency is authorized to prescribe Federal drinking water standards only for water supplies used by interstate carriers. Furthermore, these standards may only be enforced with respect to contaminants capable of causing communicable disease. In contrast, this bill would (1) authorize the Environmental Protection Agency to establish Federal standards for protection from all harmful contaminants, which standards would be applicable to all public water systems, and (2) establish a joint Federal-State system for assuring compliance with these standards and for protecting underground sources of drinking water.

BRIEF SUMMARY

In summary, this legislation would—

(1)(a) require the Administrator of the Environmental Protection Agency to prescribe national primary drinking water regulations for contaminants which may adversely affect the public health;

(b) provide that such regulations are to apply to public water systems and are to protect health to the maximum extent feasible;

Part D—General Provisions

Section 1431. Emergency Powers

Section 1431 reflects the Committee's determination to confer completely adequate authority to deal promptly and effectively with emergency situations which jeopardize the health of persons.

The authority conferred by this section is intended to override any limitations upon the Administrator's authority found elsewhere in the bill. Thus, the section authorizes the Administrator to issue such orders as may be necessary (including reporting, monitoring, entry and inspection orders) to protect the health of persons, as well as to commence civil actions for injunctive relief for the same purpose.

The authority to take emergency action is intended to be applicable not only to potential hazards presented by contaminants which are subject to primary drinking water regulations, but also to those presented by unregulated contaminants.

The authority conferred hereby is intended to be broad enough to permit the Administrator to issue orders to owners or operators of public water systems, to State or local governmental units, to State or local officials, owners or operators of underground injection wells, to area or point source polluters, and to any other person whose action or inaction requires prompt regulation to protect the public health. Such orders may be issued and enforced notwithstanding the existence of any exemption, variance, permit, license, regulation, order or other requirement. Such orders may be issued to obtain relevant information about impending or actual emergencies, to require the issuance of notice so as to alert the public to a hazard, to prevent a hazardous condition from materializing, to treat or reduce hazardous situations once they have arisen, or to provide alternative safe water supply sources in the event any drinking water source which is relied upon becomes hazardous or unuseable.

Willful violation of the Administrator's order is made punishable by a fine of up to $5,000 per day of violation.

In using the words "that appropriate State or local authorities have not acted to protect the health of persons," the Committee intends to direct the Administrator to refrain from precipitous preemption of effective State or local emergency abatement efforts. However, if State or local efforts are not forthcoming in timely fashion or are not effective to prevent or treat the hazardous condition, this provision should not bar prompt enforcement by the Administrator.

In using the words "imminent and substantial endangerment to the health of persons," the Committee intends that this broad administrative authority not be used when the system of regulatory authorities provided elsewhere in the bill could be used adequately to protect the public health. Nor is the emergency authority to be used in cases where the risk of harm is remote in time, completely speculative in nature, or *de minimis* in degree. However, as in the case of *U.S.* v. *United States Steel*, Civ. Act. No. 71–1041 (N.D. Ala. 1971), under the Clean Air Act, the Committee intends that this language be construed by the courts and the Administrator so as to give paramount importance to the objective of protection of the public health. Administrative and judicial implementation of this authority must occur early enough to prevent the potential hazard from materializing. This means that "imminence" must be considered in light of the time it may take to prepare administrative orders or moving papers, to commence and complete litigation, and to permit issuance, notification, implementation, and enforcement of administrative or court orders to protect the public health.

Furthermore, while the risk of harm must be "imminent" for the Administrator to act, the harm itself need not be. Thus, for example, the Administrator may invoke this section when there is an imminent likelihood of the introduction into drinking water of contaminants that may cause health damage after a period of latency.

Among those situations in which the endangerment may be regarded as "substantial" are the following: (1) a substantial likelihood that contaminants capable of causing adverse health effects will be ingested by consumers if preventive action is not taken; (2) a substantial statistical probability that disease will result from the presence of contaminants in drinking water; or (3) the threat of substantial or serious harm (such as exposure to carcinogenic agents or other hazardous contaminants).

SECTION 1441. ASSURANCE OF AVAILABILITY OF ADEQUATE SUPPLIES OF CHEMICALS NECESSARY FOR TREATMENT OF WATER

Temporary certification authority

Section 1441 authorizes the Administrator to issue certificates of need for chlorine or other chemicals or substances necessary for treatment of water in public water systems or in public wastewater treatment works. A certificate of need may be issued upon a petition of any person who uses such chemical or substance in a public water system or public treatment works, but who is (or will be) unable to obtain the amount needed for effective treatment. This provision is intended to permit a petition to be filed in advance of the date on which the system or treatment works will completely run out of the required chemical or substance.

The procedures governing submission and consideration of a petition for certification of need are set forth in subsection (b). No later than 30 days after the notice of receipt of a petition has been published, unless such notice is waived to protect the public health, the Administrator must act to grant or deny the certificate. This period is a maximum, and the Committee would anticipate even more prompt action by EPA in the case of a severe shortage or complete lack of necessary substances. The Committee, of course, encourages producers to take the initiative upon the publication of notice to voluntarily supply the petitioners, thereby making a government action unnecessary.

If, however, the requirements of the petitioner are not met on a voluntary basis and if the Administrator issues a certificate of need, he is to specify the chemical or substances needed, the amount which is needed, and the time period for which it is needed. No certificate may remain in effect for more than one year, although subsequent additional certifications may be issued to the same person. The purpose of this provision is to assure that at least annually the Administrator will take a fresh look at market conditions and the efforts of the petitioner to see whether the chemical or substance would continue to be unavailable to that person, absent mandatory allocation orders.

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Public Water Supply Systems

EXHIBIT 10

? Help Reports

Name:	ALGOMA WATERWORKS	**DNR Public Water Supply ID:**	43102807
Type:	Municipal community	**Status:**	Active
DNR Region:	Northeast Region	**County:**	Kewaunee
Address:	1407 FLORA AVE	**City:**	ALGOMA
Zip Code:	54201	**Population:**	3357
Transient Population:		**% Surface Water:**	
% Ground Water:	100	**% Purchased Ground Water:**	
% Purchased Surface Water:		**Service Connects:**	
Water Meters:		**Storage Capacity:**	
Service Types:	City	**Most Recent Sanitary Survey:**	06/11/2013
Season Begins:		**Season Ends:**	
Provides water to another system:	No	**Receives water from another system:**	No

Contacts

Name	Type	End Date	Phone	E-Mail
MASSART, CHRISTOPHER G	CERT OPERATOR	certification: 11/01/2017	Not available	Not available
WIESE, SCOTT A	CERT OPERATOR	certification: 11/01/2017	Not available	Not available
ANDERSON, WENDY	DNR_REP		920-662-5414	Wendy.Anderson@wisconsin.gov
HAACK, PETER - GENERAL MGR	EMERGENCY		Not available	Not available
WISWELL, JEFF - CLERK	OWNER		Not available	Not available
WISWELL, JEFF - CLERK	PLAN_CON		Not available	Not available
MASSART, CHRISTOPHER - WATER OIC	SAMPLER		Not available	Not available

Records 1 to 7 of 7

Active Dates

Start	End
01/01/1960	

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Bacteriological Samples

Help Reports

PWS ID 43102807 ALGOMA WATERWORKS

Source	Well #	Sample ID	Sample Date	Type	# Samples	Coliform Detect	Fecal Detect	Reason for No Results
(none)	(none)	178039001	02/03/2015	Distribution	1	No	No	
(none)	(none)	178038001	02/03/2015	Distribution	1	No	No	
(none)	(none)	176813001	01/21/2015	Distribution	1	No	No	
(none)	(none)	176812001	01/21/2015	Distribution	1	No	No	
3	BG096	176814001	01/21/2015	Raw Water / Well	1	No	No	
(none)	(none)	174789001	01/06/2015	Distribution	1	No	No	
(none)	(none)	174793001	01/06/2015	Distribution	1	No	No	
1	BG094	174782001	01/06/2015	Raw Water / Well	1	No	No	
5	BG097	174783001	01/06/2015	Raw Water / Well	1	No	No	
(none)	(none)	173208001	12/16/2014	Distribution	1	No	No	
(none)	(none)	173207001	12/16/2014	Distribution	1	No	No	
(none)	(none)	172144001	12/09/2014	Distribution	1	No	No	
(none)	(none)	172143001	12/09/2014	Distribution	1	No	No	
(none)	(none)	169302001	11/18/2014	Distribution	1	No	No	
(none)	(none)	169303001	11/18/2014	Distribution	1	No	No	
(none)	(none)	14AL1308	11/11/2014	Investigation	1	No	No	
(none)	(none)	167175001	11/04/2014	Distribution	1	No	No	
(none)	(none)	167173001	11/04/2014	Distribution	1	No	No	
(none)	(none)	165441001	10/23/2014	Distribution	1	No	No	
(none)	(none)	165439001	10/23/2014	Distribution	1	No	No	

Records 1 to 20 of 1659

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Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Other (non-bacteriological) Samples

Help Reports

PWS ID 43102807 ALGOMA WATERWORKS

Sample Group:	Inorganics
Source ID:	1
Well #:	BG094
Sample ID:	842686
Sample Date:	02/10/2015
Sample Time (24-hour clock):	901
Type:	Compliance
Reported Date:	02/16/2015
Reason:	SDWA
Source:	Entry Point
# Samples:	1
Collector:	C MASSART
Lab Id:	721026460
Lab Name:	Northern Lake Service Inc. (Crandon)

Sampling Results

Code	Description	Result	Units	Qualifier	Limit of Detection	Limit of Quantification	MCL	MCL Units
1040	NITRATE (N03-N)	.63	MG/L		0.025	0.075	10	MG/L

Record 1 of 1

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Last Revised: 02/18/2015

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Public Water Supply Systems

Help Reports

Name:	KEWAUNEE WATERWORKS	**DNR Public Water Supply ID:**	43102818
Type:	Municipal community	**Status:**	Active
DNR Region:	Northeast Region	**County:**	Kewaunee
Address:	401 5TH ST	**City:**	KEWAUNEE
Zip Code:	54216	**Population:**	2951
Transient Population:		**% Surface Water:**	
% Ground Water:	100	**% Purchased Ground Water:**	
% Purchased Surface Water:		**Service Connects:**	
Water Meters:		**Storage Capacity:**	
Service Types:	City	**Most Recent Sanitary Survey:**	09/10/2014
Season Begins:		**Season Ends:**	
Provides water to another system:	No	**Receives water from another system:**	No

Contacts

Name	Type	End Date	Phone	E-Mail
MURPHY, MATTHEW R	CERT OPERATOR	certification: 11/01/2015	Not available	Not available
SISEL, MARK A	CERT OPERATOR	certification: 05/01/2016	Not available	Not available
MURPHY, MATT - OIC	CONTACT		Not available	Not available
ANDERSON, WENDY	DNR_REP		920-662-5414	Wendy.Anderson@wisconsin.gov
PETERSEN, CHARLIE - PUBLIC WORKS DIRECTOR	EMERGENCY		Not available	Not available
SISEL, MARK	OPERATOR		Not available	Not available
KRANZ, BRIAN W - CITY ADMIN	OWNER		Not available	Not available
KRANZ, BRIAN W - CITY ADMIN	PLAN_CON		Not available	Not available
MURPHY, MATT - OIC	SAMPLER		Not available	Not available

Records 1 to 9 of 9

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Bacteriological Samples

Help Reports

PWS ID 43102818 KEWAUNEE WATERWORKS

Source	Well #	Sample ID	Sample Date	Type	# Samples	Coliform Detect	Fecal Detect	Reason for No Results
(none)	(none)	179088001	02/10/2015	Distribution	1	No	No	
(none)	(none)	177927001	02/02/2015	Distribution	1	No	No	
3	EK450	177954001	02/02/2015	Raw Water / Well	1	No	No	
(none)	(none)	176588001	01/20/2015	Distribution	1	No	No	
(none)	(none)	175692001	01/13/2015	Distribution	1	No	No	
(none)	(none)	174786001	01/06/2015	Distribution	1	No	No	
1	BG098	174811001	01/06/2015	Raw Water / Well	1	No	No	
(none)	(none)	171722001	12/08/2014	Distribution	1	No	No	
3	EK450	171732001	12/08/2014	Raw Water / Well	1	No	No	
(none)	(none)	170507001	12/01/2014	Distribution	1	No	No	
(none)	(none)	170509001	12/01/2014	Distribution	1	No	No	
(none)	(none)	169912001	11/24/2014	Distribution	1	No	No	
(none)	(none)	169297001	11/18/2014	Distribution	1	No	No	
(none)	(none)	167196001	11/04/2014	Distribution	1	No	No	
2	BG099	167207001	11/04/2014	Raw Water / Well	1	No	No	
(none)	(none)	165723001	10/27/2014	Distribution	1	No	No	
(none)	(none)	165048001	10/21/2014	Distribution	1	No	No	
(none)	(none)	163778001	10/14/2014	Distribution	1	No	No	
1	BG098	163821001	10/14/2014	Raw Water / Well	1	No	No	
(none)	(none)	159069001	09/22/2014	Distribution	1	No	No	

Records 1 to 20 of 2289

Next Last

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Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Other (non-bacteriological) Samples

? Help Reports

PWS ID 43102818 KEWAUNEE WATERWORKS

Sample Group:	Nitrate
Source ID:	200
Well #:	(none)
Sample ID:	707204
Sample Date:	02/26/2013
Sample Time (24-hour clock):	700
Type:	Compliance
Reported Date:	03/14/2013
Reason:	SDWA
Source:	Entry Point
# Samples:	1
Collector:	M MURPHY
Lab Id:	721026460
Lab Name:	Northern Lake Service Inc. (Crandon)

Sampling Results

Code	Description	Result	Units	Qualifier	Limit of Detection	Limit of Quantification	MCL	MCL Units
1040	NITRATE (N03-N)	.069	MG/L	Between LOD and LOQ	.025	.075	10	MG/L

Record 1 of 1

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Last Revised: 02/18/2015

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Public Water Supply Systems

Help Reports

Name:	LUXEMBURG WATERWORKS	**DNR Public Water Supply ID:**	43102829
Type:	Municipal community	**Status:**	Active
DNR Region:	Northeast Region	**County:**	Kewaunee
Address:	206 MAPLE	**City:**	LUXEMBURG
Zip Code:	54217	**Population:**	2571
Transient Population:		**% Surface Water:**	
% Ground Water:	100	**% Purchased Ground Water:**	
% Purchased Surface Water:		**Service Connects:**	
Water Meters:		**Storage Capacity:**	
Service Types:	Village	**Most Recent Sanitary Survey:**	05/01/2012
Season Begins:		**Season Ends:**	
Provides water to another system:	No	**Receives water from another system:**	No

Contacts

Name	Type	End Date	Phone	E-Mail
SIMONAR, RICHARD	CERT OPERATOR	certification: 05/01/2015	Not available	Not available
ANDERSON, WENDY	DNR_REP		920-662-5414	Wendy.Anderson@wisconsin.gov
SIMONAR, RICHARD	EMERGENCY		Not available	Not available
JANDRIN, KATHY - CLERK	OWNER		Not available	Not available
JANDRIN, KATHY - CLERK	PLAN_CON		Not available	Not available
SIMONAR, RICHARD	SAMPLER		Not available	Not available

Records 1 to 6 of 6

Active Dates

Start	End
01/01/1960	

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Bacteriological Samples

Help Reports

PWS ID 43102829 LUXEMBURG WATERWORKS

Source	Well #	Sample ID	Sample Date	Type	# Samples	Coliform Detect	Fecal Detect	Reason for No Results
(none)	(none)	179076001	02/10/2015	Distribution	1	No	No	
(none)	(none)	177933001	02/02/2015	Distribution	1	No	No	
(none)	(none)	177171001	01/26/2015	Distribution	1	No	No	
(none)	(none)	176806001	01/21/2015	Distribution	1	No	No	
(none)	(none)	174938001	01/07/2015	Distribution	1	No	No	
(none)	(none)	172674001	12/15/2014	Distribution	1	No	No	
1	KY591	172661001	12/15/2014	Raw Water / Well	1	No	No	
2	BG101	172659001	12/15/2014	Raw Water / Well	1	No	No	
3	AY363	172664001	12/15/2014	Raw Water / Well	1	No	No	
4	WN982	172656001	12/15/2014	Raw Water / Well	1	No	No	
(none)	(none)	170498001	12/01/2014	Distribution	1	No	No	
(none)	(none)	170499001	12/01/2014	Distribution	1	No	No	
(none)	(none)	14AL1346	11/20/2014	New	1	No	No	
(none)	(none)	168904001	11/17/2014	Distribution	1	No	No	
(none)	(none)	166793001	11/03/2014	Distribution	1	No	No	
(none)	(none)	166791001	11/03/2014	Distribution	1	No	No	
(none)	(none)	164661001	10/20/2014	Distribution	1	No	No	
(none)	(none)	164659001	10/20/2014	Distribution	1	No	No	
(none)	(none)	162016001	10/06/2014	Distribution	1	No	No	
(none)	(none)	158676001	09/22/2014	Distribution	1	No	No	

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Last Revised: 02/18/2015

Wisconsin Department of Natural Resources

Wisconsin DNR Drinking Water data

Other (non-bacteriological) Samples

Help Reports

PWS ID 43102829 LUXEMBURG WATERWORKS

Sample Group:	Nitrate
Source ID:	200
Well #:	(none)
Sample ID:	729856
Sample Date:	07/09/2013
Sample Time (24-hour clock):	1500
Type:	Compliance
Reported Date:	07/16/2013
Reason:	SDWA
Source:	Entry Point
# Samples:	1
Collector:	C DEQUAINE
Lab Id:	721026460
Lab Name:	Northern Lake Service Inc. (Crandon)

Sampling Results

Code	Description	Result	Units	Qualifier	Limit of Detection	Limit of Quantification	MCL	MCL Units
1040	NITRATE (N03-N)	.55	MG/L		.025	.075	10	MG/L

Record 1 of 1

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Last Revised: 02/18/2015

EXHIBIT 11

STATE OF WISCONSIN DEPARTMENT OF NATURAL RESOURCES

NOTICE OF FINAL DETERMINATION TO REISSUE A WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM (WPDES) PERMIT No. WI-0061824-03-0

Permittee: Burr Oak Heifers LLC, P.O. Box 122, Coloma, WI, 54930

Facility Where Discharge Occurs: Burr Oak Heifers LLC, NWQ, Sec. 36, T18N, R7E

Receiving Water And Location: Surface water and groundwater within the Little Roche-A-Cri Watershed

Facility Description: Burr Oak Heifers, LLC, (BOH) has been issued a water quality protection permit previously held by Opitz Custom Heifers. The Department had a 41-day public comment period on the proposed WPDES permit for this operation and held a public informational hearing on the permit on Tuesday, April 15, 2014. DNR previously approved engineering design plans for barns, feed storage and waste storage submitted by Burr Oak Heifers. Design plans will result in significant upgrades at the site, going above and beyond what's normally required in permits, in order to minimize groundwater impacts to the greatest extent possible. In addition, DNR is requiring the installation of two additional groundwater monitoring wells to provide comprehensive monitoring within the BOH Production area to detect any potential problems. The operation will keep animals housed in barns over concrete. The designs provide a higher level of water quality protection than normally required because past practices by the former operator of the site contributed to groundwater nitrate contamination. The designs are intended to prevent further nitrate in the manure from leaching into groundwater. When complete, the operation will house 3,100 heifers that will produce an estimated 3.32 million gallons of liquid manure and 45,900 tons of solid manure annually.

Land application of manure and process wastewater from the operation will be done in accordance with a DNR approved Nutrient Management Plan (NMP). The DNR-approved plan confirms Burr Oak Heifers will need to use 1,988 acres of the 2,982 total acres available on an annual basis for landspreading. The plan contains management practices to minimize the risk for manure nutrient losses from sand soils to groundwater.

Permit Drafter: Terence Kafka, DNR, 5301 Rib Mountain Drive, Wausau, WI, 54401, (715) 355-1363

Date Permit Signed/Issued: December 2, 2014
Date of Effectiveness: January 1, 2015
Date of Expiration: December 31, 2019

Following the public informational hearing, the Department has made a final determination to reissue the WPDES permit for the above-named permittee. The permit application information from the WPDES permit file, comments received on the proposed permit and applicable Wis. Adm. Codes were used as a basis for this final determination.

The Department has the authority to issue, modify, suspend, or revoke WPDES permits and to establish effluent limitations and permit conditions under ch. 283, Stats.

A summary of significant comments and any significant changes to the permit are included in the "Response to Comments" document which can be found at: http://dnr.wi.gov/topic/AgBusiness/CAFO/BurrOakHeifers.html

Changes to the Burr Oak Heifer WPDES permit regarding Nitrate Alternative Concentrate Limit (ACL)
The Department received a number of comments expressing concerns about granting an exemption to the groundwater standard for nitrate under the BOH WPDES permit (and in opposition to the proposed ACL of 28 mg/L). Due to questions concerning how background groundwater quality flowing onto the site was calculated and the possibility of a groundwater flow divide being located within the BOH production area, the Department has determined that it is appropriate to defer a decision on the proposed nitrate groundwater quality standard exemption and ACL. Issuing the BOH WPDES permit, while deferring a decision on a nitrate exemption and ACL, will result in the permittee being required to continue taking necessary response actions under ch. NR 140, Wis. Adm. Code, that address nitrate enforcement standard exceedances caused by past practices by Opitz Custom heifers at the site. Current response actions being implemented at BOH under s. NR 140.26(2), Table 6, Items 1 and 2, are a revision of operational procedures at the facility and a change in facility design and construction.

During the permit term, BOH will monitor groundwater at the facility and the Department will evaluate the concentration of nitrate in groundwater to determine if any new releases of the substance are occurring. If the Department determines that new releases of nitrate are occurring, additional response actions will be required at the facility to minimize the concentration of the substance in groundwater and prevent new releases from traveling beyond the facility design management zone, or other applicable points of standards application.

Issuance of the WPDES permit ensures that these response actions will continue, including an upgrade of the facility groundwater monitoring system, collection of additional groundwater elevation measurements and groundwater quality samples for analysis. With the additional groundwater monitoring results, Department staff will be better able to evaluate and verify groundwater flow and background groundwater quality at the site, and determine whether to grant an exemption and establish an ACL at the next permit issuance.

As provided by s. 283.63, Stats., and ch. NR 203, Wis. Adm. Code, persons desiring further adjudicative review of this final determination may request a public adjudicatory hearing. Any such request shall be made by filing a verified petition for review with the Secretary of the Department of Natural Resources within 60 days of the date the permit was signed (see permit signature date above). Further information regarding the conduct and nature of public adjudicatory hearings may be obtained by contacting the Department of Natural Resources, Bureau of Watershed Management, WPDES Permits, Box 7921, Madison, Wisconsin 53707 and by review of ch. NR 203, Wis. Adm. Code, s. 283.63 Stats., and other applicable law, including s. 227.42, Stats..

Information on file for this permit action may be inspected and copied at either the above named permit drafter's address or the above named basin engineer's address, Monday through Friday (except holidays), between 9:00 a.m. and 3:30 p.m. Information on this permit action may also be obtained by calling the permit drafter at (715) 355-1363 or by writing to the Department. Reasonable costs (usually 20 cents per page) will be charged for copies of information in the file other than the public notice and fact sheet. Pursuant to the Americans with Disabilities Act, reasonable accommodation, including the provision of informational material in an alternative format, will be made to qualified individuals upon request.

Wisconsin dairies, environmentalists watching closely after waste ruling

EXHIBIT 12

POSTED ON JANUARY 16, 2015

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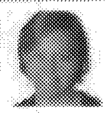

By Kate Prengaman / Yakima Herald-Republic
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A federal judge's ruling that improperly managed manure from a Yakima Valley dairy amounts to open dumping of a solid waste quickly caught the attention of environmentalists in Wisconsin that have been battling dairies over alleged nitrate pollution.

"You have all of Wisconsin and probably the nation watching closely what's going on in the Yakima Valley," said Nancy Utesch, who co-founded Kewaunee CARES (Citizens Advocating Responsible Environmental Stewardship), a Wisconsin group that opposes industrial-scale agriculture.

The decision Wednesday by U.S. District Judge Thomas Rice of Spokane sets up a trial to determine how much pollution the dairy, Cow Palace, is causing and what remedy is necessary.

While attorneys agree that Rice's ruling is the first of its kind because he determined manure in this situation to be solid waste subject to pollution laws, a decision by the U.S. District Court in Eastern Washington does not have any direct legal impact on litigation in other jurisdictions.

The suit was brought by Granger-based Community Action for Restoration of the Environment (CARE) and the Washington, D.C.-based Center for Food Safety against the Cow Palace and three other Lower Valley dairies, whose cases are set to follow this one.

CARE alleged violations of the Resource Conservation and Recovery Act, which governs the disposal of solid and hazardous waste. Dairies have long argued, and successfully in many cases, that manure is a nutrient — a beneficial byproduct — not a solid waste.

But while Utesch and others are excited about the potential precedent set by the Yakima Valley case, a Madison, Wis.-based attorney who's been involved in several lawsuits over manure pollution said it might not apply directly to the situation in Wisconsin.

That's because the data collected at the Cow Palace and in the nearby groundwater by the Environmental Protection Agency demonstrated a link with the specific dairy as a source of pollution, said Kimberlee Wright, executive director of Midwest Environmental Advocates. The areas where dairy manure pollution is a concern in northeast Wisconsin don't have such clearly identified sources, she said.

"Under the Resource and Conservation Recovery Act, you have to identify the sources," Wright said. "In Kewaunee County, where we have so many dairies, it's really hard without testing of some kind to prove whose cows are contributing."

Last year, Wright's organization and several other Wisconsin environmental groups petitioned the EPA to use its authority under the Safe Drinking Water Act to address the issue of manure pollution, as the agency did with the Lower Valley dairy cluster in 2013.

The EPA has not yet responded to the October petition in Wisconsin.

That leaves lots of people in the rural county living with unsafe well water. About 30 percent of private wells in Kewaunee County were deemed unsafe in 2013, due to either nitrates or bacteria, according to a story by the Wisconsin Center for Investigative Journalism.

While Rice found that the pollution around the Cow Palace resulted from manure mismanagement, studies in Wisconsin have shown that even dairy operators who follow good farming practices are contributing to the problem limiting the ability of a lawsuit like the Yakima case to address the pollution, said Wisconsin Center for Investigativ Journalism reporter Kate Golden.

The bedrock in the area naturally has cracks, which allow water to drain from fields straight into the groundwater, without being filtered first through soil and rock.

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